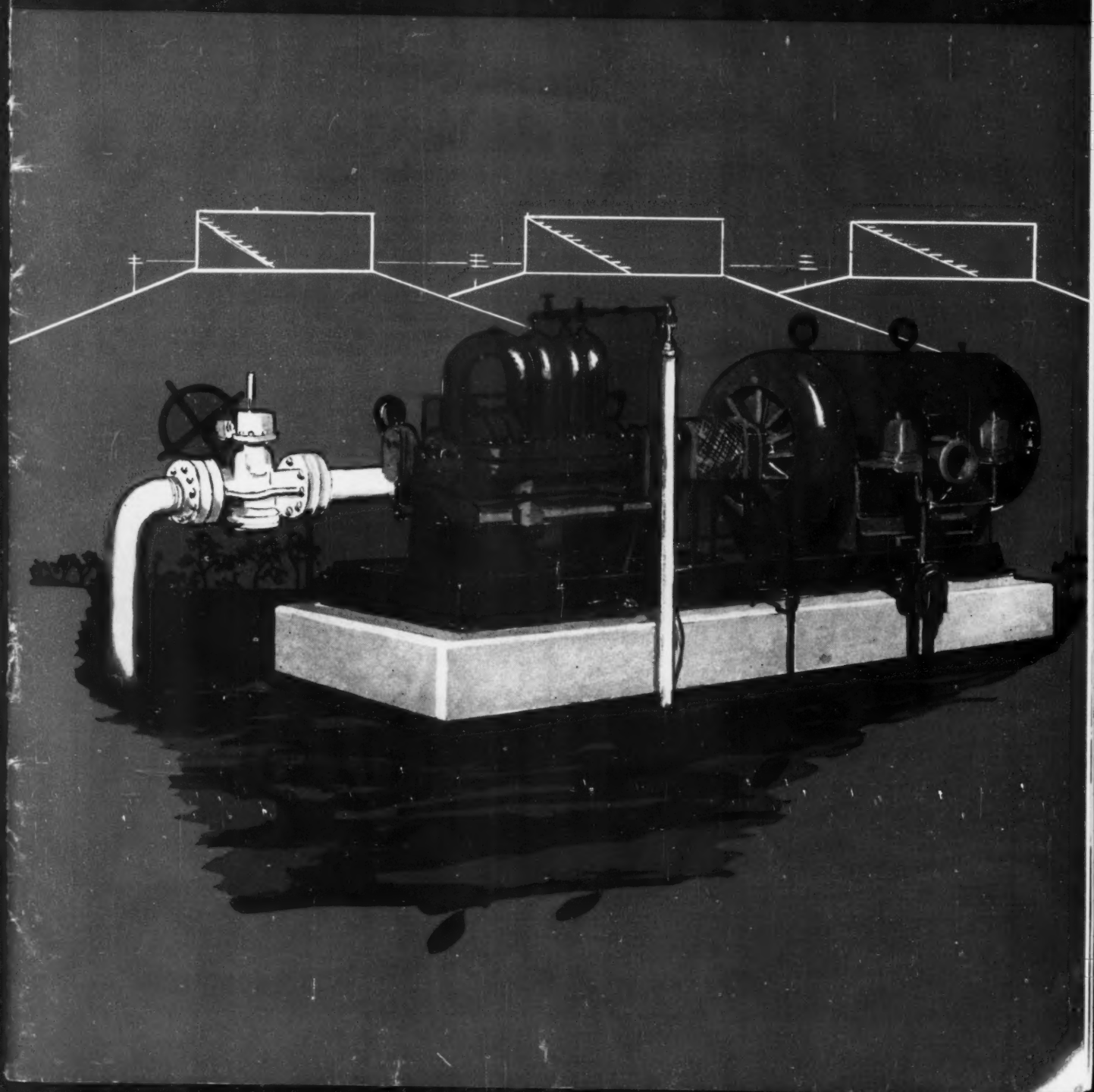
NLGI Spokesman

Journal of National Lubricating Grease Institute



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CITIES SERVICE

President's page

by G. A. OLSEN, President, N L G I

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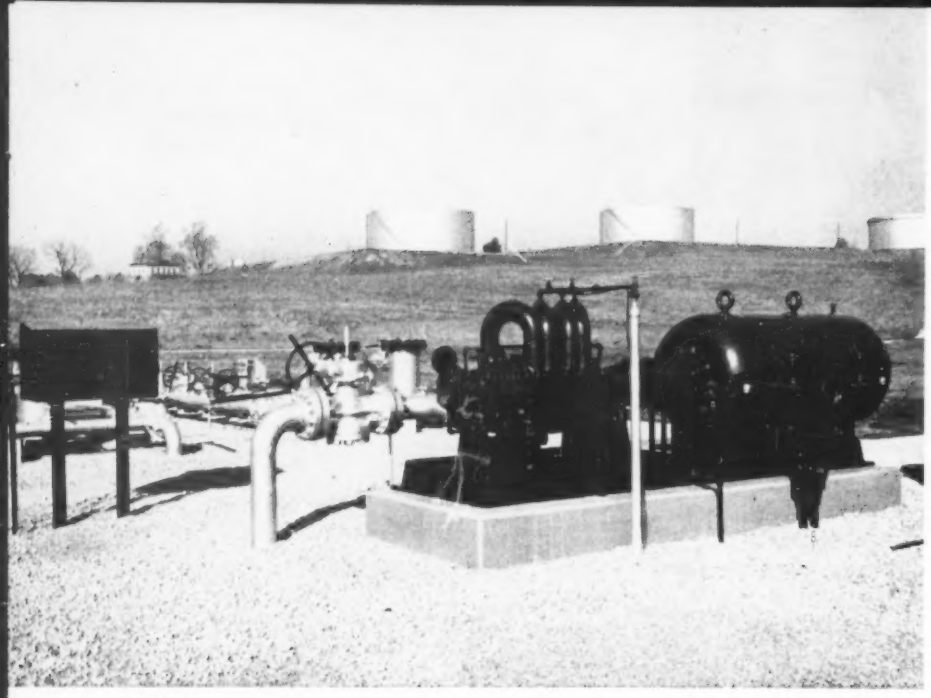
ABOUT THE COVER

This month we gave our artist, Ronald Jones, one of the pictures illustrating an article in this issue, "Greases for Electric Motors." Here is his concept of an outdoor installation subject to wind, sand and rain for five years or more with no bearing trouble.



Type of outdoor installation subject to wind, sand and rain for five years or more with no bearing trouble.

Greases for Electric Motors

E. G. Jackson
E. R. Booser

Thomson Laboratory
General Electric Company

THE FIELD of lubrication in electric motors is at the happy state of having available a number of excellent greases. Neverthless, there do exist potentialities for improvement in this field as in every other. The increasing demands being placed on electric motors require greases which better lubricate and protect motor bearings while providing low torque. These greases must also maintain their physical and chemical stability over longer periods of time. A large amount of field experience and extensive laboratory testing have developed a background of experience from which we now venture to segregate compositions and properties common to good greases. By this path, a proposed specification is developed for hypothetical greases which should offer three to four times the life possible with greases of the past.

The final criterion of a good grease must always be that it provide long useful service. Examples of such service in electric motors are widespread though not so widely published. A recent paper[1] surveyed the operation of thirty-four motors which ran for five years under severe conditions with only four bearing failures. The conditions of the bearings after an average of over 36,000 hours operation are shown in Figure 1. The conclusion was that for this service five years was too long a period to plan on yet, but only because the safety margin was too narrow. Unpublished tests still continuing in our laboratory are going into their sixth year with six different greases running under less rigorous conditions. These motors run continuously except for one overnight shutdown each week, and at the last inspection all but one grease seemed capable of sustaining years more of service. Table I shows the results of a recent inspection after five years of operation. All six motors are still running.

These are just two examples of the length of service

that has been provided by good greases in ball bearing electric motors. For easy service, in the temperature range of —25° to 200 F, five years has represented a more than adequate safety margin on grease life with a number of available products. Not all applications, however, are so readily satisfied by our present day greases. The tendency to pack more and more power into smaller bundles, whether giant turbine generators or fractional horsepower motors, results in higher ambient bearing temperatures. This is straining the resources of available greases, especially when the same grease is required to encompass both extremes.

To meet this challenge, as well as to obtain permanent lubrication at moderate temperatures, we shall consider the factors that seem to be important for greases lubricating electric motors. Although these factors vary greatly in their importance for different types of service, they represent the normal demands on greases in well over 95% of the motors now in service.

TABLE I

Five Year Inspection of Greases in Electric Motors

3600 RPM, 3 HP motors, 306 open bearings, 160 lb. belt pull, 104° F bearing housing temperature

Grease	*Oil Content (Wt. %)* *Original*	*Five Yr.*	*Appearance*
A. Petroleum	79	75	Slightly dry in one bearing, soft and oily in the other
B. Petroleum	75	72	Very soft and moist, slightly rancid
C. Petroleum	76	73	Soft and moist
D. Silicone	80	75	Dark, soft, moist
E. Silicone	65	61	Like new
F. Diester	84	83	Soft, moist and smooth

TABLE II

Whip Test Results Compared with Life in Bearings

Grease	*Micropenetration (3) Initial*	*Final**	*Hours Mean Life in No. 306 Bearing at 212° F. 3600 RPM (5) Open Bearing*	*Double Sealed Bearing*
		Common Open Bearing Greases		
G	90	>420	>10,000	----
H	66	360	8,000	----
B	44	170	4,400	1400†
A	90	>420	2,000	480†
I	55	205	----	----
		Common Sealed Bearing Greases		
C	93	80	2,000	4600
F	61	130	1,900	3200
J	40	80	2,500	2900†
D	54	85	1,900‡	2000‡
K	56	120	----	1000
L	74	300	----	----

*After running 24 hours at room temperature and 1800 RPM with lock nut and lock washer on 306 open bearing and with 100% full charge of grease (approx. 70 gms).
†Double shielded.
‡302° F.

Physical Stability

First, because it is so obvious, the lubricant has to stay in the bearing where it is needed. This means that the oil in the grease must neither bleed too fast nor evaporate, and the grease must have sufficient consistency to remain in the bearing while being fluid enough to lubricate. Considerable data have been accumulated so that figures for these factors can be quoted which, while not precise for all applications, will give an order of magnitude.

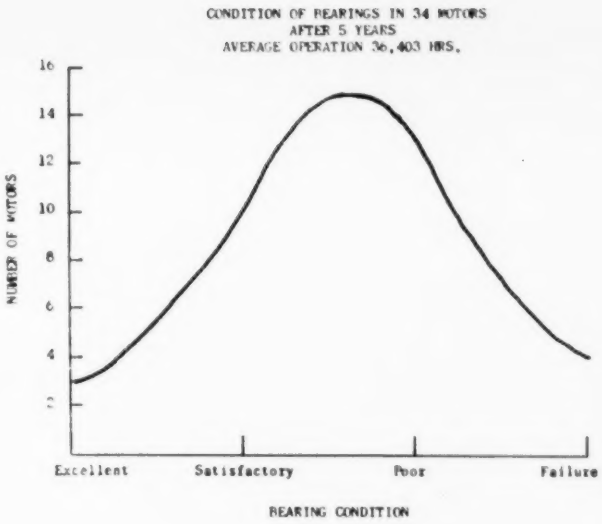
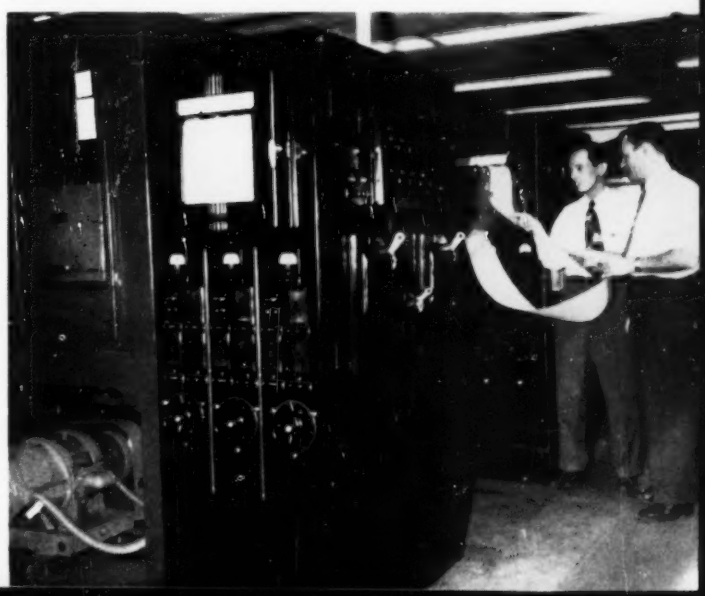


Figure 1

Currently, the best greases for electric motors have initial bleeding rates in cone bleeding tests of about 0.2 percent per hour at 212°F. This bleeding rate decreases with time until the bearing fails. The final bleeding rate will depend on the viscosity of the oil and the temperature of operation. Generally, the higher the oil viscosity, the lower will be the minimum rate required but also the lower the total useful bleeding. A maximum total bleeding of 10% in the first 500 hours at 212°F in a static cone has been found with most of the better motor greases.

The evaporation rate should be as low as possible so that losses of oil are minimized. This factor is inherently even more important than bleeding since oil lost by evaporation can be of no conceivable use in bearing operation. It has been found that in order to get 1000 hours life in

The authors discuss the record of a grease life test. The temperature of the outer race is continually recorded and variations are significant.



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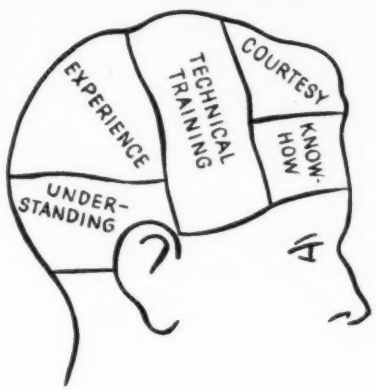

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a 306 bearing, the vapor pressure of the oil in the grease must be of the order of 0.05 mm Hg or less at the operating temperature.[2] An evaporation loss of less than 2% by weight in 500 hours at 212°F in a static bleeding cone test also seems desirable as a measure of low grease volatility.

Until more is known of the relation of the structural details of a grease to its performance, a consistency measurement must continue to be used as a criterion of correct construction. Most electric motors with open bearings in regreasable housings, from fractional horsepower to large ball bearing motors, use a grease of worked penetration 265 to 295. Somewhat stiffer greases in the range of about 230 to 280 seem better for double sealed and double shielded bearings.

Although the electron microscope technique now permits examination of the structure of greases, no given structure can be called for a priori because so many different kinds are detected in a variety of good greases. It is true that most greases with outstanding performance characteristics in motors are of the fibrous type common to soda soap thickeners. However, other shapes such as rods and clusters are found in greases—both in soaps and in non-soaps which are being reported as giving satisfactory service. A few examples of structure photos are shown in Figure 2.

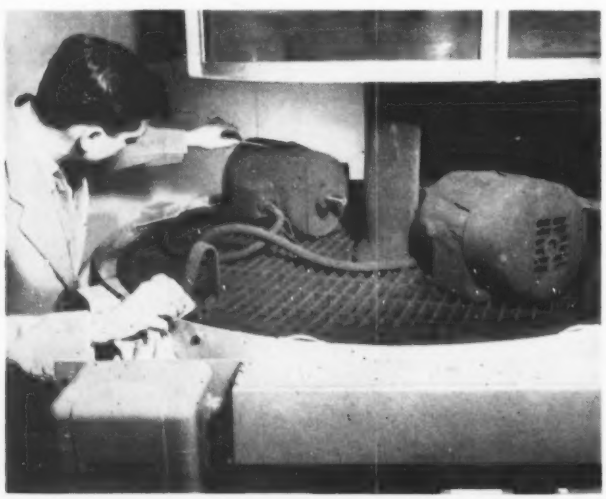
One useful performance factor that might eventually be predicted from such structure studies is that of resisting churning. We know that consistency is not the sole criterion of a good channeling grease, for some of the stiffest churn badly and some of the softest resist it well. Greases for electric motors must be able to resist this type of breakdown, which is particularly prevalent in large bearings and in sealed bearings as well as over-lubricated open bearings.

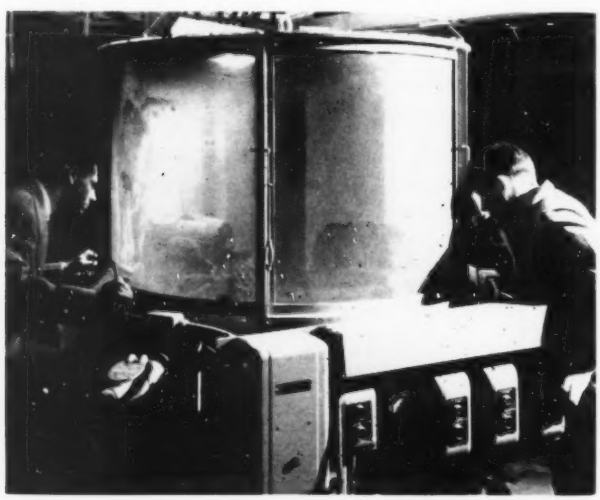
This churning factor has been checked in our laboratory by measuring the degree of softening of greases when subjected to the shearing and churning of a rotating ball bearing with its lock nut and lock washer in an over-packed housing. Table II shows such "whip test" results for greases commonly used in open or in sealed bearings, along with the hours of life obtained in open and sealed bearings in high temperature performance tests with these greases. It is seen that the greases that perform best in one type of bearing are not best in the other and that the whip test fairly well indicates this. Greases which perform best in double sealed and double shielded bearings soften very little in the whip test, usually showing a final micropenetration below 150. These greases must quickly channel to avoid the churning action of the rotating ball complement with which they are held in such close proximity by the seals or shields of the bearing. More feedability is required for good operation in the larger grease reservoir of an open bearing housing. With proper packing of a housing about two-thirds full, excellent life has been obtained from greases which whip badly when over-packed. A limiting micropenetration of 250 in the whip test for open bearing greases will cover products with satisfactory feedability while largely eliminating the need for precautions against over-greasing.

Lubrication

A primary requirement of a grease in a motor is simply that it supply the very small amount of oil essential to keep the bearing operating. The actual quantity of lubricant supply necessary from the grease increases with bearing size, speed, load and operating temperature, and with decreasing oil viscosity in the grease [4]. Some approximate analyses of the lubrication requirements indicate that an oil feed of less than one-thousandth of a drop per hour is necessary for various ball bearings in the 15 to 50 mm bore size running at 3600 RPM with a 300 SUS viscosity oil. This extremely low oil requirement of ball bearings emphasizes the need for a slow bleeding grease with good oxidation stability for long life.

No extreme pressure or lubricity additives appear necessary in grease, judging from examination of hundreds of bearing from electric motors operating in the field with various lubricants. The general lack of need for lubricity improvement in petroleum greases is somewhat surprising since the Hertz stresses in the rolling contact areas between balls and races range up to several hundred thousand pounds per square inch at even moderate loads. A hydrodynamic effect or the many-thousand





Electric motors being subjected to dust chamber test. A labyrinth seal packed with lubrication grease has been found to be very effective in resisting penetration by abrasive dust into the bearings. Without the lubricating grease, no labyrinth is effective.

Figure 2—A FEW EXAMPLES OF STRUCTURE PHOTOS ARE SHOWN HERE

Petroleum Oil
Lithium Soap

Petroleum Oil
Sodium Soap

Petroleum Oil
Strontium Soap

Petroleum Oil
Sodium Soap

Silicone Oil
Lithium Soap

Silicone Oil
Silica

Petroleum-Diester Oil
Lithium Soap

Silicone-Diester Oil
Lithium Soap

Silicone Oil
Urea Derivative

fold increase in the viscosity of the oil at the high contact pressure in a ball bearing may account for the lack of dependence on lubricity. Good operation is obtained as long as the surface roughness of the bearing is covered by a film of oil.[1] Whatever the reason, sufficient load capacity is available with oils down to viscosities of about 30 SUS.

Nevertheless, some minimum lubricating quality in the oil is necessary. Ordinary silicone greases with their poor steel-on-steel lubricating properties, for instance, give erratic operation in heavily loaded bearings or when the speed factor (bore in mm multiplied by the shaft speed in RPM) exceeds about 150,000 to 200,000.

Lubricating grease which has been fluidized by churning in the whip test.

Bearing Protection

A third function of grease is that of shielding the bearing from dust, dirt and moisture. Many motors in industry are used in dusty atmosphere such as mines and mills, or outdoors exposed to rain and windblown dust. It is always better to make a general purpose motor satisfactory for wide usage rather than to design special motors for every application. Grease when used properly helps to relieve design problems by providing effective seals.

Grease protects bearings from moisture in more than one way. It can act as a simple physical barrier, the principal mechanism of water-insoluble soap greases, or it can absorb small amounts of water and so keep it from rusting the bearings, as sodium base soaps can do. Even with more water than can be absorbed, the sodium soap may offer protection by dissolving in the water and acting as a rust inhibitor at the metal surface. While non-water-soluble soaps may lack this mechanism, they appear from severe laboratory tests to provide good protection if they are applied so as to cover completely all metal parts. And, of course, they will resist more water washing than sodium soaps.

Both types of greases will serve efficiently to bar foreign matter from the bearing when used in a simple housing. We have found by experiment that no labyrinth is an effective dust barrier unless it is filled with grease. Then it will protect the bearings much longer than a rubbing seal on the bearing.

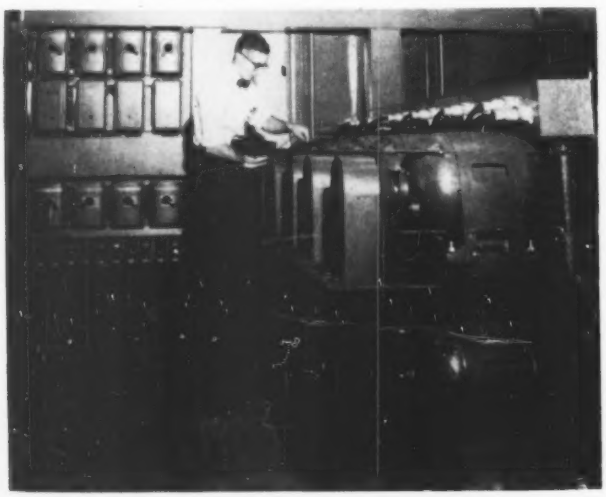
Low Torque

In fulfilling its other functions, the grease should offer as little resistance as possible to the bearing operation. Both the power loss during normal running, and the starting torque required at low temperature are generally of interest in grease selection.

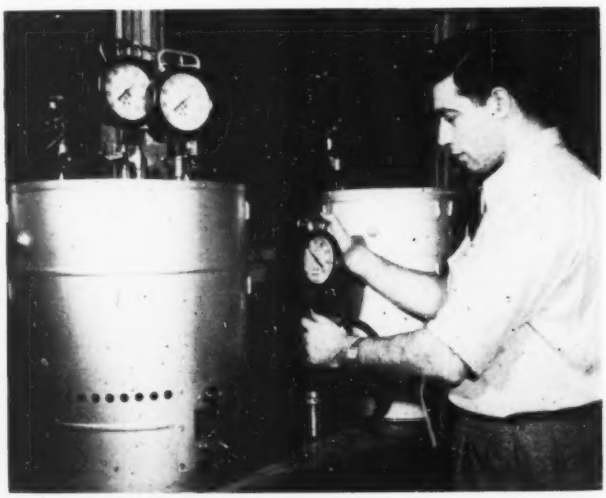
The power lost in bearings is actually a small proportion of the motor output. Losses are of the order of 1% for 5 horsepower motors, are a higher percentage for smaller motors, and a smaller proportion in large units. Other factors are often more important for avoiding high friction than just slight loss of efficiency. The increased friction shows up in higher bearing temperature with correspondingly shorter grease life and possibly excessive bleeding. High torque greases also often give trouble with noisy operation and vibration.

The properties required in a grease for low power loss are not clearly defined. Generally there is a tendency for high loss with nonchanneling characteristics and with high oil viscosity. Nevertheless, viscosity itself is not critical, as power losses have been found essentially the same for many Grade 2 greases with oils having viscosities ranging from 70 to 2000 Saybolt seconds at 100°F.

Electric motors should be able to operate at temperatures down to —25°F to be satisfactory for general use throughout the United States. The ability of a grease to provide this low temperature operation can be readily tested by checking the torque of a greased bearing in the laboratory. A value of 1000 gm-cm in a No. 204 bearing at 1 RPM has been found to be the limiting torque for operation of medium sized motors and this torque corres-



Bearing housing temperatures are being observed here. These motors are part of a number of all sizes being run to check grease performance in actual operation.



This picture shows oxygen pressure in a Norma-Hoffmann bomb being adjusted.

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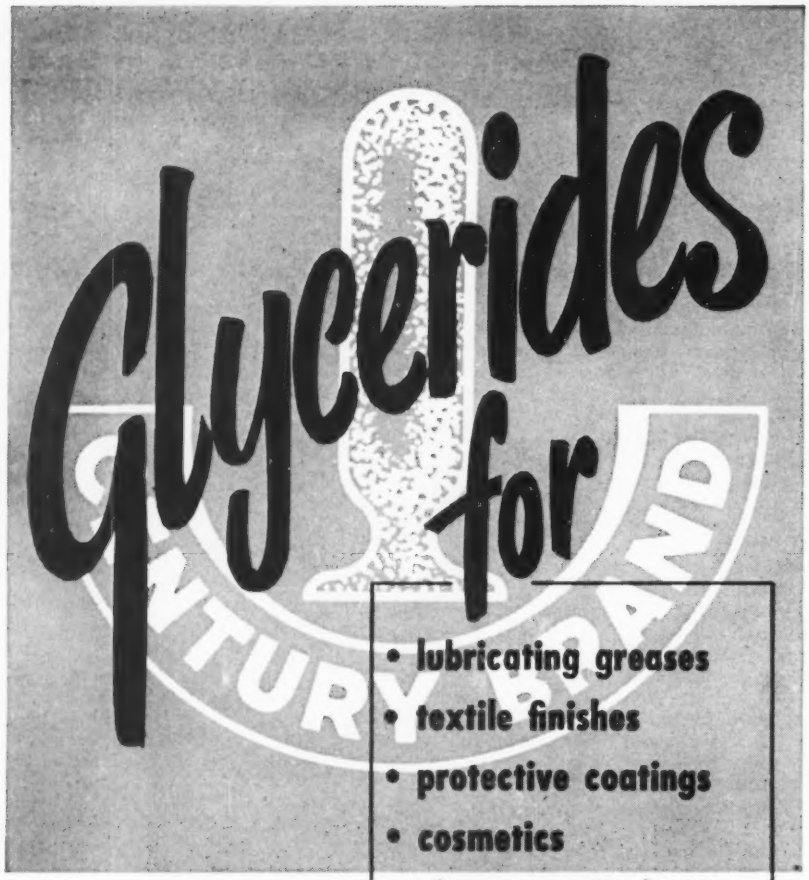

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Saponification Number	176-184
Iodine Value (WIJS)	1-5
Melting Point (°C)	82-85
Hydroxyl Value	155-165
Acetyl Value	137-148

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SPECIFICATIONS

Titre	(136.4-140.0°F) 58-60.0°C
Iodine Value (WIJS)	1-3
Free Fatty Acid	1-3%
Acid Number	2-6
Saponification Value	190-195
Color 5¼" Lovibond Column (Max.)	15 Yellow-2 Red

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sponds to an oil viscosity of 500,000 SUS in many greases[2]. For various viscosity index oils, then, the approximate maximum 100°F viscosity for a −25°F grease can be estimated from Table III.

TABLE III
Limiting Oil Viscosity for Satisfactory Low Temperature Operation

Oil Viscosity Index	*Approx. Highest 100°F Oil Viscosity for −25° F Grease, SUS*
100	510
90	440
80	380
70	340
60	310

From these values, it would seem desirable to have a high viscosity index oil of about 400 to 500 second viscosity at 100°F. This should provide maximum stability and a minimum evaporation rate while still enabling satisfactory low temperature operation. With a viscosity index of 60 to 70, a 300 second oil would be called for.

Chemical Stability

Besides the physical stability already referred to, grease for electric motors, as for most purposes, must have chemical stability. Essentially this means resistance to oxidation. Oxidation of the soap can break down the structure of the grease and permit excessive bleeding. Oxidation of the oil results in its thickening and eventual solidification. Ball bearings will, fortunately, be lubricated by oxidized oil as long as any is still fluid.

There is as yet no good short time criterion for oxidation stability in electric motors. The standard Norma-Hoffmann test is recognized to be an index more of storage life than of operational life. A dynamic grease oxidation tester has recently been developed in which a grease packed ball bearing is magnetically rotated in a bomb. We hope soon to have enough data to be able to determine the performance necessary for satisfactory life in electric motors. Data may be accumulated in a short time because bomb oxidation proceeds so much more rapidly when the grease is being stirred. A life test may be run in one week, for example.

In lieu of simpler measures of oxidation stability, ball bearings operating under motor speeds and loads have been employed extensively in the laboratory to evaluate grease life.[3] A listing is made in Table IV of the life test results for a number of greases together with bleeding, evaporation, oxygen bomb life, and oil viscosity data. The almost complete lack of correlation between individual factors is evident. The over 10,000 hour life with the grease with a 200 SUS oil indicates that high viscosity in itself is not essential to long life. Low volatility, however, is important and the generally lower volatility with increased oil viscosity would suggest use of the most viscous oil possible while still having satisfactory low temperature operation. The chemical composition of the soap does not seem critical, since good results have been obtained with soda, soda-calcium, lithium, and strontium soap greases. Hours in a static oxygen bomb is seen to give little correlation with life. Even the poorest life was obtained with a grease giving fairly good bomb test results. This poorest grease became encrusted with a hard surface layer which apparently interfered with its normal feeding of lubricant to the bearings.

Compatibility between greases is another form of stability required of a grease for use in electric motors. Ideally, any good grease should form a satisfactory mixture with any other. And fortunately, this is so in practice to a great extent. Although a mixture of greases having radically different soaps may have an appreciably lower dropping point than either of the individual greases, such cases are rare and we have found no instances in which serious differences in penetration resulted from working grease mixtures. Nevertheless, any candidate for widespread use in electric motors must be examined with the thought in mind that in the field, it may be put on top of a previously used grease.

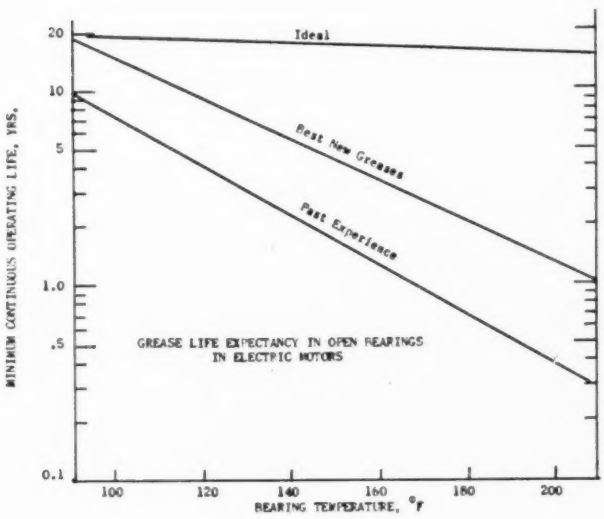

Figure III

One of the authors preparing a bearing for a minimum oil test.

TABLE IV

Characteristics of Several Ball Bearing Greases

Grease	*Geometric Mean Life, Hrs. at 212° F in No. 306 Ball Bearing, 3600 RPM* (5)	*Oil Viscosity, SUS, 100° F*	*Bleeding,* Wt. %, 700 Hrs. at 212° F*	*Evaporation,* Wt. % 700 Hrs. at 212° F*	*N-H Bomb Test,† Hrs. to 20 psi Drop at 210° F*
M	>10,000	2200	4.0	5.0	....
N	>10,000	500	6.0	3.0	>800
G	>10,000	200	19.5	1.6	>700
B	4,400	700	7.3	2.5	250
O	2,800	300	11.4	4.7	....
J	2,500	500	.1	6.0	>400
P	2,500	300	15.1	5.0	50
C	2,000	300	4.7	5.5	450
A	2,000	300	7.1	5.8	200
F	1,900	70	7.2	1.8	3200
Q	1,700	280	3.6	15.6	....
R	1,600	200	10.0	7.9	40
S	1,200	283	..	..	600

*By modified MIL-G-3278 procedure.
†A.S.T.M. Method D942-50.

Proposed Specification

On the basis of these requirements and the general relations found between performance and grease properties, an attempt can now be made at proposing a specification which should cover ideal electric motor greases. Such a specification is indicated in Table V.

Of the factors in the specification, the performance characteristics are felt to be of primary importance. The life expectancy with such a grease in open bearings at various temperatures is compared in Figure 3 with that of greases normally available in the past. Also indicated is the ideal life of greases for present motors which reflects the approximate insulation life at high temperature and an approximate obsolescence life at lower temperatures. The physical properties, composition, bleeding and evaporation, and oxygen bomb test requirements are presented largely as guides which may be helpful in arriving at the desired performance. With a low volatility oil, for instance, the viscosity could very well be considerably lower than the 500 seconds limit indicated. Somewhat lower penetration might also be desirable with some soap types.

A parallel specification is given for greases for use in double shielded and double sealed bearings. In these bearing types a somewhat lower penetration grease is generally desirable along with better stability under severe whipping conditions. The life of the better greases in these enclosed bearings has been found lower than for suitable greases in open bearings. This may result partly from the severe requirements on physical stability which eliminates use of many greases with good chemical stability. The restricted reservoir of grease available for lubrication in the double sealed type may also be at least partially responsible for the shorter life.

No greases have yet been found which entirely meet the performance requirements of this specification. Several so nearly do that it seems a matter of a short time until some such outstanding products will be developed from raw material now at hand. The availability of such greases from many suppliers would be most desirable.

The development of these ideal greases will represent an important achievement by the grease industry in aiding the electric motor manufacturers in their never ending search for designs and materials to give longer life and easier maintenance of their products.

TABLE V

Proposed Specification for Electric Motor Greases

PROPERTIES	*Open Bearings*	*Double Sealed Bearings*
Worked Penetration	265-295	230-280
Oil Viscosity, SUS at 100° F	500 max.	500 max.
Viscosity Index	(See Table II)	(See Table II)
Soap Type	Na-Ca, Li, Na	Na,Na-Ca, Li
N-H Bomb, Hrs. to 20 psi drop at 210° F	750 min.	750 min.
Bleeding, Wt. % in 500 Hrs. at 212° F	10 max.	5 max.
Evaporation, in 500 Hrs. at 212° F	2 max.	2 max.
PERFORMANCE		
Low Temperature Limit for 1000 Gm-Cm Starting Torque in 204 bearing	−25° F	−25° F
Mean Life at 212° F, 306 bearings at 3600 RPM hrs.	10,000 min.	5,000 min.
Micropenetration after 25 hrs. in over-packed bearing	250 max.	150 max.
Rust protection	Satisfactory	Satisfactory
Compatibility	With all common ball bearing greases	

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DISCUSSION

Presented by

E. M. HIGGINS, *Master Lubricants Company*
Philadelphia, Pennsylvania

THE PAPER as offered by Dr. Jackson and Dr. Booser is another example of the work of the Bearing and Lubricant Center of General Electric's Thomson Laboratory. It shows the infinite care and orderliness with which they perform the task of evaluating greases.

Conclusions are arrived at slowly, with many preliminary tests working up to the operational or functional tests.

Where life values are constantly being lengthened with new materials, the expense of truly evaluating greases becomes more time consuming and expensive.

Many times, at the point of electric motor manufacture, little is known concerning the operating conditions which will be encountered when they are placed in service. It is therefore imperative that a lubricant be used which will handle as many combinations of operating variables as possible and still provide long service life.

It is difficult to find a single grease which will offer long, reliable service in not only a wide range of operating temperatures and speeds but in the many types of bearings and housing designs found today in the electric motors manufactured in this country.

The vast majority of electric motors in service at the present time operate at normal or near normal temperatures. As indicated in this paper however, the future points to designs which will offer much more severe operating conditions. Therefore, in accordance with good planning for the future, the need for the efforts of Dr. Jackson and Dr. Booser are as necessary as they are timely. Their work is inspiring to our industry from the standpoint of their presenting a challenge to grease manufacturers for the production of lubricants superior to those we have produced in the past.

For many years, exhaustive tests have been made with small, high speed bearings operating at high temperatures. It is unlikely that results obtained in these small bearings will correlate with tests using larger sizes.

Many motor manufacturers use various types of roller bearings which have more demanding lubrication requirements than small ball bearings.

It has been found that a minimum amount of oil satisfies the lubrication of small bearings. Therefore, moderate bleeding at least, is highly desirable for good lubrication. However, there may be a question as to the rate of bleeding for adequate lubricant supply to larger bearings with their wider ball, roller and retainer contacts, combined with heavier loads.

As stated, the majority of electric motor bearings in the field at the present time do not operate at high temperatures and this again might influence continuous good lubrication where there are no elevated temperatures to assist the bleeding rate.

Success in lubricating traction motors where heavy shock loads may help in feeding grease to the bearings, may not offer a secure yardstick on which to base the lubrication requirements of smooth, vibrationless industrial motors.

The Whip Test is a rather new standard for determining one phase of the lubricant's value. It may be highly effective in screening greases for ball bearings but the test results do not necessarily apply to roller bearings which in practice have been more successfully lubricated with relatively soft greases.

Combinations of slow speed as well as higher speed roller bearings and a grease which immediately or eventually strongly channels, can give trouble through lack of lubrication. At least this has been our experience. Flanges and retainers require more lubrication than the rolling elements.

For many years, field service engineers from ball bearing manufacturers and lubricant companies, together with plant lubrication engineers, have recommended moderately packed housings. This has unquestionably resulted in better lubrication conditions. If the inexpedient practice of completely filling electric motor bearing housings with grease continues, it might spread to other types of antifriction bearing applications with undesirable results. From an economy standpoint, it would promote waste, while maintenance on motors could be increased as a result of winding damage.

Some of the data outlined in the tables are just about as confusing as they are enlightening.

Table III
Limiting Oil Viscosity for Satisfactory Low Temperature Operation

This chart would indicate that if an oil with a 510 @ 100 F. viscosity is used, it should have a V.I. of 100 for low temperature low torque and operability at −25 F. If a 310 viscosity oil is employed the V.I. should be 60.

A grease is available which passes cold test requirements at −30 F. with an oil viscosity of 500 and a V.I. of 60. Here we find a suitable oil at the extreme opposite end of both suggested requirements.

Table IV
Characteristics of Several Ball Bearing Greases

The first three greases on Table 4 offer about as wide a range of primary test characteristics as could be imagined yet they are equally capable of leading the large group of test greases performance-wise.

It would therefore be very difficult to pin-point the most satisfactory grease for long service life on viscosity alone. Not only is a wide range of viscosity shown but also substantially different bleeding rates.

The most amazing is Grease G with its unusually high bleeding rate. This type of grease might eventually cause winding contamination due to oil creepage. The possibility would be even more critical where product dusts exist.

The evaporation rate of the oil in Grease M is considerably higher than the rate in Grease G with its very low oil viscosity. It would seem that this is just about opposite to what might be normally expected, thus, it would make you wonder whether a suitable grease is made by accident or by good planning.

In Table Five there are two unsolved performance requirements, tests for rust prevention and compatability.

The humidity cabinet tests have not proved adequate. They do not reproduce conditions found in a bearing

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and housing assembly because emulsions which form are washed into the base of the test set and lost. They are retained in a conventional bearing housing. The humidity cabinet tests throw out many soda soap greases which, in actual practice offer excellent rust prevention in the presence of limited quantities of water normally encountered.

Rust has been observed with most types of waterproof greases in textile and paper mill bearings as well as in machine shops where moisture is a problem. These have been replaced by soda soap greases and much better reactions have been noted because of protective emulsions being formed. Idle equipment offers considerably more severe requirements for rust protection than equipment in constant operation. While a channeling type of grease might have many desirable attributes for bearing operation, the low bleeding rate type, providing only a thin film of oil on the ball and race areas, might offer very poor protection from rust.

Compatability is another phase which has not as yet been adequately defined by any approved test procedure.

Results of Worked Admixtures of Lithium and Soda Soap Greases

Some soap mixtures not only end up with a much lower melting point which may not be too important or serious for normal operation but also produce greases of much higher penetrations. This could cause undesirable leakage in motors, particularly in units which are vertically operated.

TABLE VI

Results of Worked Admixtures of Lithium and Soda Soap Greases

	Worked 60 Strokes	*Worked 100M Strokes*	*ASTM Drop Point*
INDIVIDUAL GREASES			
L-1	282	303	382
L-2	260	286	390
L-3	237	263	395
S-1	283	315	382
S-2	286	347	500+
S-3	237	310	500+
S-4	227	342	400
ADMIXTURE 50-50%			
S-1 and L-1	282	344	287
S-1 and L-2	268	317	284
S-2 and L-1	285	378	276
S-4 and L-3	236	305	294
S-3 and L-3	235	300	297

L–Lithium Soap Base
S–Soda Soap Grease

It is hoped that sooner or later, the ASTM will develop reliable testing equipment for evaluating these two important Performance phases of bearing protection.

I wish to thank the Authors and the NLGI Program Committee for allowing me to offer comments on this very fine paper.

DISCUSSION

Presented by

HENRY E. MAHNCKE, *Westinghouse Electric Corp. East Pittsburgh, Pennsylvania*

The need for a rational approach to the subject of grease specification for electric motors has been apparent for some considerable time. My first and only previous attendance at an NLGI meeting was nine years ago in this same location. Even then the question of greases for electric motors was a matter of considerable discussion but one felt that there was some hestitancy in regard to the matter of definite specifications.

Now there is a change in the atmosphere which is apparent in the presentation of this paper, which is, I feel, a highly commendable attempt to introduce some order into a somewhat chaotic situation. The authors are also to be commended for their temerity in this respect, since the promulgation of specifications of this sort is always a hazardous undertaking. However, I should like to point out that I think the authors have taken the proper approach to the problem in emphasizing those characteristics of a grease which govern its operating performance and attempting to show on the basis of experimental evidence why they arrived at a particular specification. The accumulation of more such evidence offers the only possibility of eventually arriving at an acceptable specification. It is to be hoped therefore that this paper will serve as a starting point for a more concerted effort on the part of both producers and consumers of motor greases to come to some more general agreement as to what characteristics of a motor grease are amenable to specification and how they may be stated so as to obtain the desired grease.

Considering the present state of the art however, we certainly agree with the authors statement that "the performance characteristics are felt to be of primary importance." We feel that the case is still not proved for a reliable correlation between laboratory tests carried out on the grease and the life of the lubricant in the bearing and that the final evaluation must be carried out in the bearing itself. Of course this presents difficulties in that we feel that a good performance test of general applicability is still not available. The greatest of these difficulties seems to be that in most proposed bearing tests the question as to whether we are testing lubricants or bearing or both at once is still not resolved. Some progress is being made in this direction with the recent availability of heat stabilized bearings fabricated with the utmost precision and the application of statistical techniques to the results. It is to be hoped that this progress will continue since more work needs to be done before a satisfactory solution is attained, particularly in the matter of obtaining reproducible results.

We must take issue specifically on the matter of open bearings vs. double sealed bearings, as there seems to be a basic misconception involved. In the business of supplying electric motors we feel that the basic necessity is one of supplying the longest life that can be built into the machine. If, for the ultimate in life, a certain type of

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grease is required, and we wish to take advantage of the inherent benefits of the double sealed bearing, then the matter of extra space for the softer grease is simply one of providing extra bearing width. Under these circumstances we do not see the need of specifying for sealed bearings either a different grease or of accepting a lower minimum life standard. In fact, if a softer grease were desirable, it could be more readily accommodated in the sealed bearing. We base this on our own tests which have shown that in sealed bearings, the rate of oil evaporation can be varied by an order of magnitude merely by varying the type of seal. Extrapolation to an open bearing indicates even greater losses. It will be interesting to see what part this will play in the dynamic oxidation tests referred to in this paper.

I should like to cite some evidence in support of the point made above. We have recently examined 562 motors with double sealed bearings of from 7½ to 15 HP operating in six textile plants on 24 hour six day a week service for 13 to 15 years. To the best of our knowledge, there have been no more than ten failures in this time and examination disclosed the grease to be still in satisfactory condition. These results could be superposed on the authors Figure 1 as a nearly single vertical line. In another sense they are a striking confirmation of the authors statement that good greases for current normal service are available, with the necessary reservation that optimum bearing design be employed.

There is another point in the proposed specification which seems to further emphasize the importance of the performance test. It is admitted that penetration, bleeding rate, and evaporation loss are probably significant factors in the operation of a bearing. However, it seems to us that oil viscosity, viscosity index and soap type specifications unnecessarily restrict the range of materials from which a satisfactory lubricant may be chosen. Such specifications will require frequent revision, particularly now that we are looking intensively for the normal lubricant of tomorrow, which is the unusual lubricant of today.

There are many questions that come to mind involving specific points and I am sure most of them will emerge in the discussion to follow. However, three of them are of particular interest to me and I should like to pose them now.

1. What criterion do the authors use for bearing failure and how reproducible is it.
2. Will the authors care to amplify somewhat their statement that "Grease when used properly helps to relieve design problems."
3. Do the authors attribute the noise and vibration associated with high torque greases, to the mechanical properties of the grease or to poor lubrication resulting from improper grease distribution.

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An informal discussion formed a part of the Technical Committee's Symposium "On Dispensing Lubricating Greases in Service Stations and Garages." Presiding is Symposium Chairman, J. F. Carter. Sitting at the table left to right are: J. M. Stokely, A. R. Boyer, John J. Gleeson, J. Reinsma, N. Marusov.

Symposium on Dispensing Lubricating Greases In Service Stations and Garages

An Informal Discussion Offered At The NLGI Technical Committee Session, October 28, 1953

This is the second part of the "Symposium on Dispensing Lubricating Greases in Service Stations and Garages" offered at the NLGI Technical Committee session, October 28, 1953. The first installment appeared in the January 1954 issue and included five viewpoints on the subject.

The five papers previously appearing and this informal discussion following the paper presentations will be available in reprint form.

Mr. Stokely: I would like to start with questions to Mr. Reinsma. How did he arrive at 50 degrees Fahrenheit as the critical temperature for pumpability, and how would he answer the complaints of service station operators in the Los Angeles area when they get a prolonged cold period, in the 30 degree range, that may extend over three or four days, and all service stations in the area are open and have no provision for heating?

Mr. Reinsma: In answer to your question of the 50 degree temperature figure, we have found that the average Service Station operator cannot efficiently operate and use the tools of lubrication in temperatures below 50 degrees.

We are well aware of the Open-Air Station locations—such as you have mentioned. We have also found that the operators of these stations are not too active in the car lubrication phase of their business when temperatures get down to 30 degrees. Applying greases to the fittings, or operating the control valve is difficult at these low temperatures.

While the 50 degree figure is one that we have arbitrarily established, it represents the average coldest condition under which a lubrication man may be expected to operate efficiently.

In view of the rapidly changing lubricant characteristics at 50 degrees, as compared to their performance at 70 degrees or higher, it is not necessary to refer to their performance at temperatures below 50 degrees.

I would like to ask Mr. Stokely a question on the winterizing of the pump. He explained that greases packed

within the pump of the motor, where oil is used to lubricate them, created a sluggishly-operated motor. So far as speed is concerned, or volume delivery, I think that relates basically to gear lubricants and motor oil. I wonder if the opinion is the slow-moving motor or the restricted motion of the air valve might not be misleading in view of the fact that we realize that we lose as much as 3,000 pounds of pressure, working pressure, in merely forcing the grease through the pipeline system, for chassis lubricants. Therefore, the speed of the motor would play a very little part in the importance of speed or speed increasing the time required for lubrication. Isn't that so?

MR. STOKELY: We found in actual pumping tests, with equipment from eight different manufacturers, that in all cases there was an increased delivery rate; in some cases, more than two to one under low temperature conditions, when cold temperature lubricants were used for the operating equipment. Therefore, this is obviously a very important variable because if the air motor is sluggish in operation, it means that you are getting an excessive friction loss in the air pump itself. The function of the lubricant is to minimize the friction loss in the air motor. Therefore, if you don't have the proper lubricant for the air motor, you will have an excessive loss of pressure and you will be unable to deliver as effectively as you would have with less power loss in the pump motor itself, regardless of the length of line.

MR. GLEESON: I have no question, but I think that everybody in the room should be well aware of the fact that the importance of all this discussion going on is that unless the requirements are met as to the extent of performing the job wanted by the manufacturer, he may, in defense of his own reputation in the efficiency of his product, seek another means of performing these jobs. I mean such as going to sealed bearings, the use of rubber and the other means of carrying the load, and, certainly and very factually, it would affect us all.

So, I think the comments and suggestions have considerable merit and are worthy of a lot of consideration and time and effort, and not only those who are assigned to the task, but those that are related in the field in their own organization. It is a big problem. I don't believe that a great many people realize the many ramifications that are necessary in order to lubricate just a simple bearing and yet do it efficiently and make sure that both the man that does the job and the man that receives it are happy and satisfied. It is a big deal and it is going to take a lot of training and promotion and a lot of push.

MR. MARUSOV: I have two questions. The first is directed to Mr. Stokely. I'm surprised that Mr. Stokely's and the NLGI's papers agreed so well on so many different points. There was, however, disagreement on one point. Mr. Stokely specified that four ounces per minute delivery was the rate at which the service station operator became a little disgruntled. This minimum rate differs with the NLGI recommendation of two ounces per minute. There is no doubt that any minimum rate would be subject to either personal attitude or circumstances which create special problems. Can Mr. Stokely give some additional information which might explain this discrepancy?

MR. STOKELY: I think that the definition of the terms is probably apropos at this point.

The two ounces per minute that the Committee is recommending, I believe, is with the NLGI test shackle in position rather than free flow. We do some of our pumpability work with the NLGI recommended shackle. We also do some of it as free flow. We have found that for simplicity many of these tests can be made with a free flow measurement at four ounces per minute, which is fairly close to the two ounces per minute with the medium shackle in position. So I believe we are in fairly close agreement.

However, either of those rates is quite empirical. There are some station operators, particularly those servicing large trucks, who would not be satisfied even with four ounces per minute in lubricating trucks that have large capacity shackles. This requirement is going to vary with every station operator. There may also be installations in which four or five dispensing nozzles are used on a single pump in long line installations for busses and truck lines, for example. Under those circumstances you are drawing grease at a more rapid rate than four ounces per minute if you are going to keep all guns supplied. Those are variables that are encountered in service.

MR. MARUSOV: The second question is directed to anyone willing to answer. Just what objections are there, if any, to the use of follower plates? It seems that the use of follower plates may be the only solution to the NLGI's slumpability problem. Can the equipment manufacturers or grease producers give us some objection or encouragement for the use of these follower plates?

MR. STOKELY: The objection is that anyone who has ever tried to take a follower plate out of the bottom of a 108 pound or 120 pound grease container realizes that it is a very dirty and disagreeable job. Therefore, you present a practical problem to the user. The general answer is, "I don't intend to use a follower plate if I can help it, and if you can't produce a grease that will flow without follower plates, then we will find somebody who will." Generally, they do.

MR. REINSMA: I think the use of follower plates is very necessary on all types of greases as there is hardly a case or hardly a type of grease used that doesn't leave a good share of the lubricant in the drum. It might be surprising and possibly not to you men, but we continually test pumps from that standpoint—from the service standpoint—and we find as high as 40 to 43 pounds of grease left in a drum without use of a follower plate, which is a pretty pathetic situation. From the sales standpoint, we find an objection because it changes the price structure of the pump. It is an added accessory that must be purchased. Secondly, it sometimes affects the sealing cover on the drum because of the mechanism directly

under the cover or the mechanism itself.

MR. BOYER: Can't you overcome the objection of dealers merely by putting something on the follower plates so that they can readily lift it out without reaching down and getting sleeves dirty and greasing their hair, and so forth? No doubt the new follower plates probably will have to be designed differently.

MR. REINSMA: It is not as difficult to remove the follower from the drum as it is to transfer 20 or more pounds of grease from the drum. If you could but see the haphazard methods being used to remove this lubricant—most anything is brought into Service for this clean-out—but seldom ever the hands. It is surprising how dexterous some operators have become with a dirty paddle of cardboard or other make-shift arrangement. With the proper technique, the follower plate may be quickly and easily removed. For the amateur, one who has not been properly instructed, I will agree he could have a difficult time.

MR. STOKELY: There is room for design for a better follower plate.

MR. BOYER: The equipment companies move slowly in their thinking. With proper thought and consideration given to the dealers' problems, I am sure equipment can be simplified.

MR. REINSMA: You brought out a point here. Mr. Gleeson brought out a point on over-lubrication of certain bearings. During that discussion, you mentioned the size of the coupler and the ramifications that it has gone through. The equipment manufacturer is in the middle. We try our best to get a car factory to place fittings in accessible positions. That has never been accomplished 100 per cent. We find that a man must have a hoist in some model cars to let the wheel come to a rest; in other words, to support the car by the frame structure to make the fittings adequate to reach with standard equipment.

On the adapter story, there are several reasons why we make many different adapters. Going along with your thinking, it would be wonderful if we could get an adapter telescopic in design, with a small nozzle, to have pressure control, a pressure release, and all those things necessary for the different bearings. Mr. Gleeson mentioned excessive pressure on bearings regarding universal joints. Some control valves do give full pressure of the pump. For that reason, on universal joints, most of the manufacturers make an adapter with a very small nozzle, but it has two purposes. One is to reach the fitting which, I agree with you, you cannot reach with a heavy couple. It will go on the fitting of a joint. I thought from what I have learned, that this is why they put the fitting in that spot. So, you have to get an adapter with a small nozzle to fit.

MR. BOYER: What actually happens in practice, the equipment salesman, being a good man, sells the dealer all these things, but the dealer will not walk two feet to put an attachment on the end of his control handle. So, consequently, nothing is done.

MR. REINSMA: The bearing is missed.

MR. BOYER: Yes. Some of our smart dealers throw this away and put the small adapter on.

MR. REINSMA: Only smart to the degree that the small coupling permits him to get to this particular fitting. What of the service to be expected from this kind of an application? The small coupler is the same as a hand gun coupling and it cannot, because of its small size, have the quality of strength and ruggedness necessary for continuous trouble-free usage under general lubrication service.

MR. BOYER: This small adapter will stand up to 10,000 pounds.

MR. REINSMA: Yes, but what about the number of applications?

MR. BOYER: Can't you think of another type of adapter? The present type is too heavy.

MR. REINSMA: The reason for that is it takes so much time to get the grease through the bearing.

MR. BOYER: There are metals today that withstand high pressures to any amount necessary, which will streamline this control handle and make it a versatile and complete unit.

MR. REINSMA: Most of us in the equipment business try to make controls as light as possible—in this case of die-casting with a steel insert. As for the adapter, we have difficulty getting an agreement from the service operators, the men you represent from under the lift. Give him an adapter to reach a difficult fitting and when you go back to him he has a piece of hose and he likes the hose idea. It requires two hands instead of one. Even after selling him on the idea of one hand, he is using two.

CHAIRMAN CARTER: I'm sorry, we are going to have to break this off. You can see what happens . . .

MR. BOYER: Just one point. The equipment people might be interested in this. We now find we do a better lubricating job with the new frame contact hoist than with the old hoist that cluttered up our floor with a bunch of iron. We take a hoist and lift the car and the wheel drops. We don't need these terrific pressures to get the lubricant through the bearing. The new hoist does a much better job and it is just a matter of evolution to replace the old-type hoists.

MR. REINSMA: Why do car manufacturers have bearings that require so many varied pressures? Present cars built today have bearings on them that require 6,000 pounds of pressure to go through them, relaxed or otherwise.

MR. GLEESON: We build a car to run and we expect you fellows to build the equipment to lubricate it.

EDITOR'S NOTE: The Panel meeting was adjourned because of the lateness of the hour.

machines that work for machines

We usually think of machines as working for men, and ultimately, of course, they all do.

But many, many machines exist only to work for other machines. You'll frequently find a machine that makes or processes component parts or materials for another machine . . . or, provides the motive power for another machine . . . or, controls another machine.

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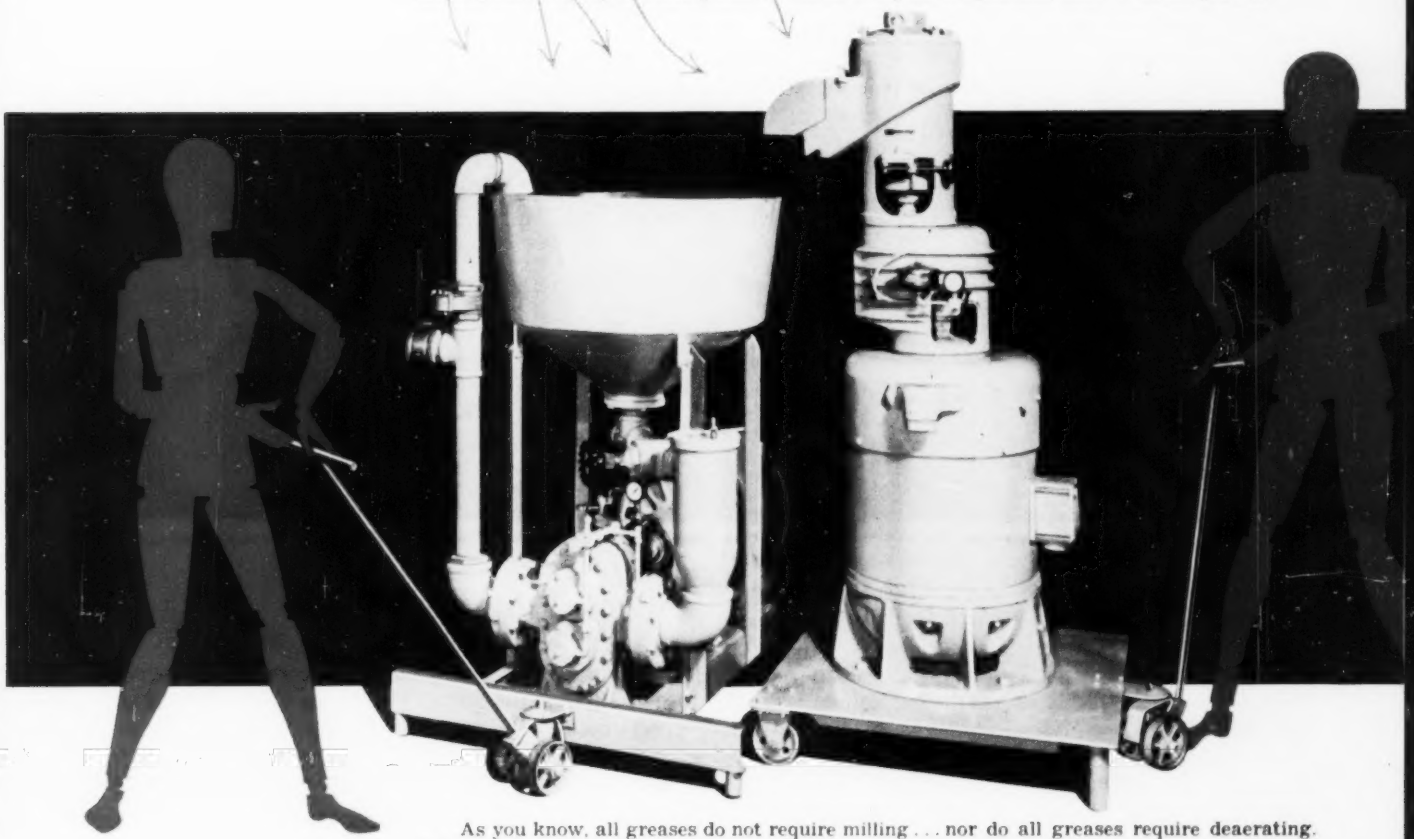

The Morehouse Mill and grease deaerating equipment illustrated produces up to 25,000 lbs. of high quality grease per hour. Each unit independent, portable. Note casters and tow attachment. Portable and non-portable units of lower capacity are also available.

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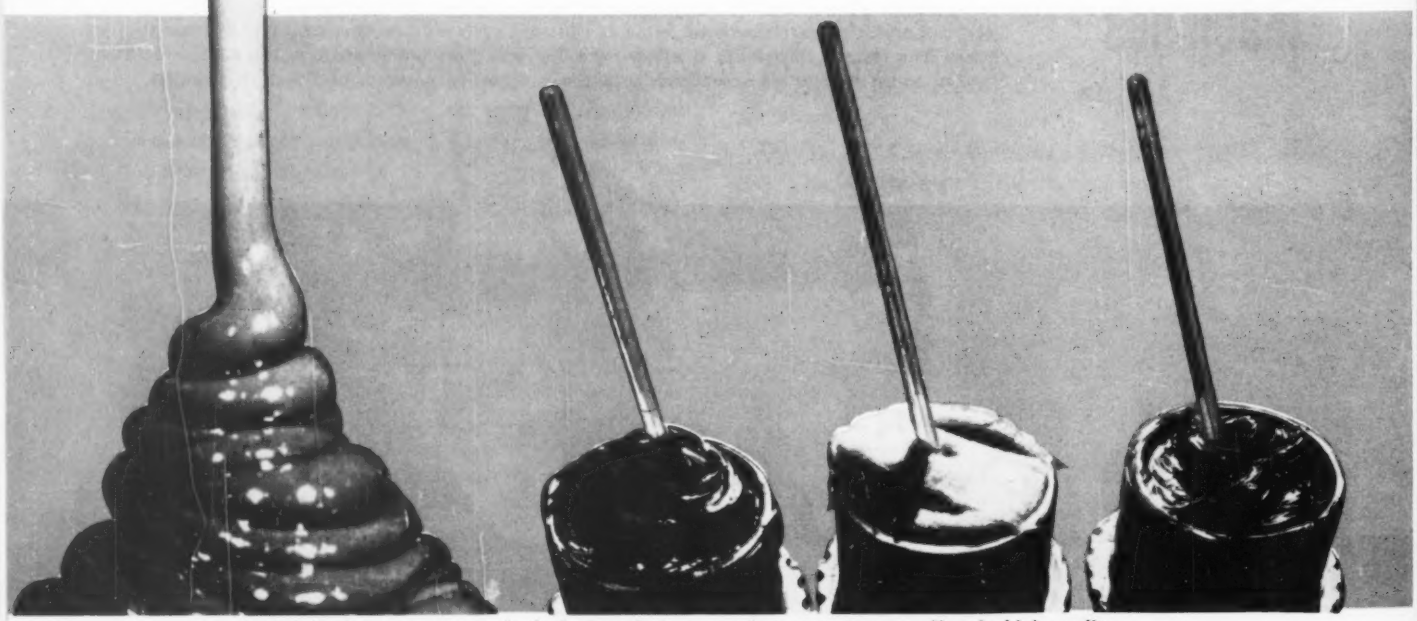


Lubricating greases are checked often during manufacture to insure uniformly high quality.

ONE MINUTE the jet fighter is taxiing down the runway of a desert air base. The next it's streaking through the far reaches of the "wide blue yonder." In no time at all, it has zoomed from scorching heat to freezing cold; from parching dryness to sub-zero humidity. Still, the plane responds instantly to the touch of the pilot's hand on the controls.

The almost unbelievable performance of modern airplanes is a tribute to the research, engineering and production genius of the aircraft industry. But it is a tribute also to a specialized branch of the petroleum industry. Even the most skillfully designed airplanes would soon fail under the severe conditions of flying if it weren't for modern lubricants. Without lubricating greases, their operating parts would quickly become a mass of crippled gears, cams, cables and bearings.

Though it is one of the more dramatic, aviation is by no means the only phase of everyday life where lubrication is vital. Lubricating greases are essential in manufacturing, transportation, agriculture, national defense and in the home. They keep steel mills producing; automobiles and railroads rolling; farming, mining and construction equipment operating; the weapons of our armed forces at the ready; and domestic appliances at peak operating efficiency.

Without lubricating greases our economy would quickly grind to a sickening halt.

To the average citizen whose only contact with the product is at a service station, greases might not *look* very different from the sticky mess that was smeared on wagon axles almost a century ago. Actually there is a world of difference.

Modern greases are conceived in the research laboratory and produced in scientific manufacturing plants. There are literally hundred of different kinds, each made according to exacting specifications. They are formulated from different base materials, blended in special ways, and fortified with as many as four or five chemical

Grease

might grind to a halt

Reprinted from September-October issue of *Ethyl News*

Steam locomotives use lubricating grease in brick form.

Lubricants—as well as fuels—help "keep 'em flying."

additives.

Lubricating greases now made resist the pounding heat of rolling mills and the freezing cold of refrigerating plants. They withstand floods of water in paper-making machinery, fruit acids in canneries, and the ceaseless turning of railroad roller bearings. They resist rust, extreme pressure and oxidation. They adhere to constantly rubbing surfaces and yet spread readily.

Greases provide economical and efficient lubrication where it would be impractical or impossible to use oil.

The first "modern" lubricating grease was made from a mixture of lime-base soap and crude petroleum from the oil springs of Pennsylvania about 1845, some 14 years before Drake's discovery well came in. Grease of non-petroleum variety, however, dates back at least to the 14th Century B. C. Egyptians of that era, it has been discovered, lubricated their chariot wheels with a mixture of animal fat and lime soap.

When petroleum greases came into use, and for many decades thereafter, grease-making became a closely-guarded craft. Skilled grease-makers mixed ingredients by feel, smell and even taste, and carried per formulas around in their heads. These artisans produced greases that were adequate for their time perhaps, but there often were wide variations in quality and consistency from batch to batch.

In recent years science and technology have stepped in.

Grease materials now are weighed and measured by accurate instruments, and are blended in exact proportions according to the tested formulas. Processing times, temperatures, pressures and other controlling factors are regulated by precision devices.

One simple description of grease-making states that "grease begins with a fat, which is made into a metallic soap, that is mixed with a petroleum oil, resulting in a lubricating grease."

How Soaps Are Made

Actually, several types of soaps are used in making different greases. These include calcium and sodium soaps, which go into the more common types, and a variety of other metallic soaps including lead, aluminum, barium, lithium and strontium for more specialized lubricants. By a process known as "saponification," soaps are made by mixing these alkali metals in heated kettles with various fats such as animal, tallow, oleic acid, degras, hydrogenated fats, naphthenic acids, or other fatty materials.

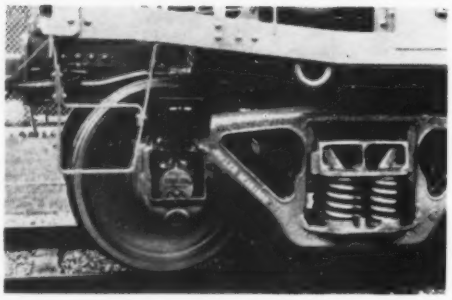
To the finished soap, lubricating oil and additives are added. They are mixed in a kettle equipped with mechanical agitators and the contents are worked constantly to insure a uniform texture. As the process nears completion, frequent laboratory tests are made to assure the desired texture, consistency and other characteristics. Finally the finished product is pumped through filters and into containers.

Lubricating greases of different consistencies, of course, are needed for different jobs. They range from solid brick greases used to lubricate the driving journals

of huge steam locomotives to the almost fluid greases required in gear boxes.

Consistency is determined by the soaps and oils used, the processes by which ingredients are combined, and the additives included. To a large extent, it is the soap that supplies the framework or structure, gives grease its semi-solid body and determines the way it will perform its lubricating task.

The petroleum oils used in grease-making vary widely. Generally speaking, however, oils of relatively low viscosity are used in greases intended for high-speed or low-temperature operation, while heavier oils are needed where the grease is to be used under low-speed and high-temperature conditions.



Railroad car roller bearings require specially-compounded lubricating greases.

Universal consistency or "hardness" classifications for greases have been established by the National Lubricating Grease Institute, a trade association of which some 95 per cent of U. S. and Canadian grease-makers are members. These classifications provide uniform standards for grease manufacturers and consumers throughout the country.

In addition to establishing these standards, the Institute makes other contributions to the welfare of the industry. It acts as a clearing house for information on lubricating greases; promotes standardization of tests in the fields of grease manufacture and use; publishes data for manufacturers, marketers and consumers of grease; collects technical information; and endeavors to promote policies beneficial to the industry.

Petroleum grease has made tremendous strides in the last decade, largely as a result of World War II. Many of the then-existing greases were found to be inadequate for equipment developed in that war, and even better products were forthcoming. The war also pinpointed the need for the multi-purpose greases that could serve for several lubrication applications and cut down on the expense of large inventories of many similar products.

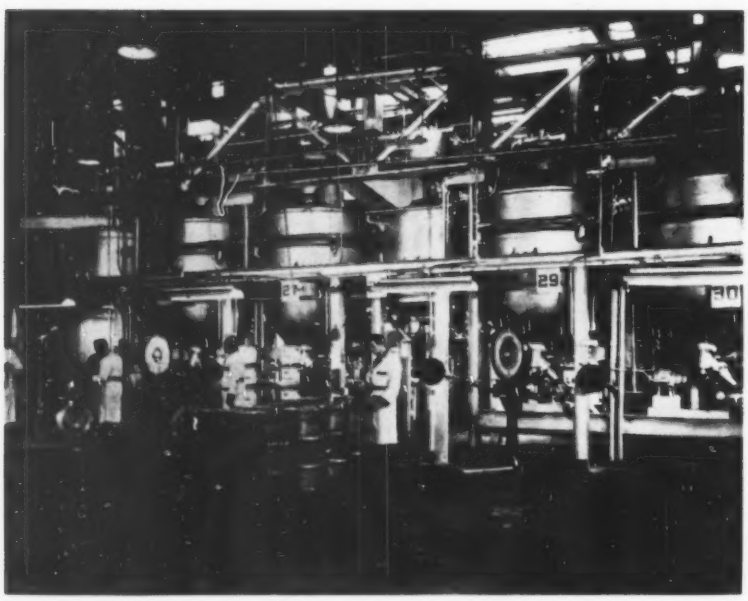
Recent Developments

One of the contributions of World War II was the lithium soap greases which were better able to remain plastic at low temperatures, stay put at high ones, and still give protection in high-speed operations. These led to some of the other metal soap greases that are successfully solving the complex lubrication problems of the Atomic Age.

For the future, the new metal soap greases and greases containing synthetic oils seem slated for more widespread use. At present, however, the high cost of the latter pretty much limits their use to the weapons and equipment of defense.

Truly, the grease-maker has become a partner in progress with the scientists, the engineer and the manufacturer. If his past performance is any indication, it's a safe bet that some day he will lubricate the rockets that speed us to the moon.

Why not? He already is supplying the grease for the jet planes that are breaking through the sound barrier and setting new altitude records.

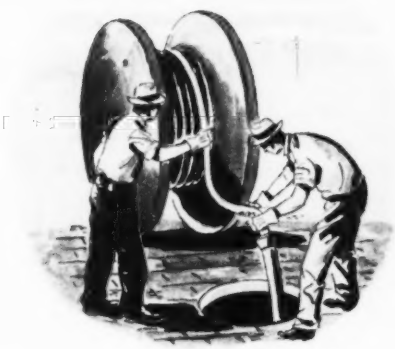


Modern lubricating greases are manufactured in quantity under exacting conditions.

Lubricating grease as the motorist best knows it.

EXPERIENCE PROVES

that greases based on Metasap* Aluminum Stearates are superior for tough lubricating jobs



Here are two applications where greases must take the heaviest sort of punishment — and do a first-rate job of lubrication:

1. Lead-covered electric cables, housed in conduits underground, suffer breaks and damaged casings unless efficient lubrication is employed to prevent the generation of excessive friction and heat when these cables are pulled through the piping which holds them.

The problem of producing lubricants able to "stand the gaff" on this job has proved a very difficult one—but it has been solved. One of the nation's leading grease manufacturers, after trying all sorts of greases, is having outstanding success with grease based on a Metasap Aluminum Stearate.

2. Farmers operating along, or near, seacoasts have particular difficulty in protecting their machinery from rust and corrosion during inclement weather—due to salt being carried inland and adding its destructive power to that of moisture and rain.

A second large grease maker, whose name is famous thruout America, has found the way to give farm machinery protection under the worst weather conditions. After testing panels coated with grease based on a Metasap Aluminum Stearate — in humidity and salt spray cabinets, for more than 1,000 hours — he has ascertained that such grease is "head and shoulders above other greases", and that it provides a top-notch protective agent for farm machinery anywhere.

Very probably a Metasap Aluminum Stearate Base can solve a problem for you. Why not consult with us? We'll be glad to help you select the correct base for any given oil, or achieve any desired effect in a finished grease through use of proper soap mixtures.

METASAP CHEMICAL COMPANY, Harrison, N. J.

Branches: CHICAGO • BOSTON • CEDARTOWN, GA. • RICHMOND, CALIF.

Stocks at: Cleveland, Ohio; Louisville, Ky.; Los Angeles, Cal.; Portland, Ore.; Spokane and Seattle, Wash.

*Reg. U.S. Pat. Off.

METASAP CHEMICAL COMPANY — REG. U.S. PAT. OFF.

Stearates

of Calcium • Aluminum • Lead • Magnesium • Zinc

Patents and Developments

OXO-Bottoms Base Greases

In the OXO process there is formed a fairly large amount of higher boiling alcohols which, so far, has found no appreciable commercial outlet. A residue of about 35% of alcohols and other products boiling above 250°C is generally obtained.

The use of such bottoms as a lubricating medium for lithium base greases is disclosed in U. S. Patent 2,653,132 issued to Standard Oil Development Company. Inspection tests on the bottoms disclose the following properties:

Flash point	over 350°F.
Pour point	<— 55°F.
Viscosity:	
100°F.	68.3 S. U. S.
210°F.	34.9 S. U. S.

They may be used directly as the synthetic oil for the grease composition, or they can be esterified with dibasic acids, such as sebacic or adipic. The greases preferably contain 10-15% by weight of lithium soap. One example given is as follows:

6.0%	lithium stearate
6.0%	lithium hydroxy stearate
87.0%	Oxo bottoms (boiling above 250°C.)
1.0%	phenyl alpha naphthylamine

Polysiloxane-Aluminum Soap Greases

A grease composition serviceable at both low and high temperatures is described in the California Research Corporation Patent 2,654,710. Resistance to emulsification also is claimed.

The composition involves use of a polysiloxane base oil and a complex basic aluminum soap. The latter contains at least one hydroxyl anion for each aluminum cation and at least two dissimilar anions substantially hydro-carbonaceous in character. This means that the radicals are composed mainly of hydrogen and carbon and include such radicals which contain, in addition, minor amounts of substituents such as chlorine, bromine, oxygen, nitrogen, etc. Examples of such complex basic aluminum soaps are aluminum benzoate stearate, aluminum benzoate oleate, aluminum benzoate 12-hydroxystearate, aluminum toluate stearate, aluminum benzoate hydrogenated rosin, etc.

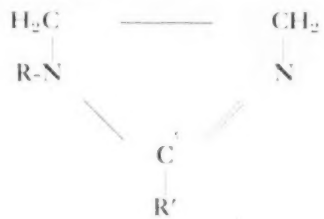
When petroleum oils are used as the base oils for greases thickened with these complex basic aluminum soaps, the greases become more gelatinous as the oleophobic-oleophilic anion ratio is increased. Also, when polysiloxanes are used as the base oils, the greases increase in consistency as the oleophobic-oleophilic anion ratio increases. It is preferred to use a basic aluminum soap wherein the free hydroxyl groups range from about 1-1.5 per aluminum cation.

The preparation of aluminum azelate stearate is given as follows:

A mixture of 13.5 parts by weight of commercial stearic acid (approximately 60% stearic acid and the remainder mainly palmitic acid) and 10 parts by weight of azelaic acid was dissolved in 400 parts by weight of water at approximately 180°F. This solution was slowly added, with stirring, to a solution of 24.9 parts by weight of aluminum sulfate octadecahydrate in 300 parts by weight of water at this same temperature. The resulting reaction mixture was filtered. The white precipitate which was formed during the reaction was washed with water by adding the white precipitate to a large amount of water and then stirring vigorously. The precipitate was washed in this manner three separate times until only a faint positive sulfate ion test was attained in the filtrate from the third wash. The resulting mixed soap was then dried at a temperature ranging from 210°F. to 250°F., was powdered and passed through a No. 60 mesh sieve.

Inorganic-Thickened Greases

The water stability of aerogel-thickened greases is claimed to be improved in the Standard Oil Company (Ohio) Patent 2,655,476 by addition of an oil-soluble, water-insoluble, surface-active polyamino imidazoline such as one having the formula



where R is the radical containing an amino group and R′ is an alkyl, alkylene, hydroxy alkyl or hydroxyalkylene group.

Calcium Silicate-Thickened Greases

Very superior lubricating greases having excellent texture and stability in addition to high dropping points and other advantages of inorganic gel greases, generally are claimed to be obtained by use of a thickening agent comprising a precipitated hydrated calcium silicate in finely divided form (not larger than 5-50 millimicrons in diameter). The greases consist of an oleaginous liquid vehicle and the aforesaid calcium silicate with or without soap or other additional thickening agent (Texas Company's Patent No. 2,656,315).

In general, the amount of calcium silicate used is about 5-45% by weight of the composition. The material has the formula $(CaO)_n(SiO_2)_m \cdot xH_2O$, where n and m are integers from 1-10 and x is an integer from 1-5. A suitable commercial material is sold under the name Silene EF.

Beeswax Containing Greases

One patent (2,658,037) issued to Chemieprodukte G.m.b.H. discloses the preparation of a superior beeswax–containing lubricating grease as follows:

500 gr. of fish oil preferably (whale oil) are saponified with 140 ccm., 37% caustic soda under slow addition of the latter. Then 1000 gr. of spindle oil are added. In place of the spindle oil, paraffin oil may be used. The mixture is heated to 170°C., so long until a test shows that a part of the mixture when placed upon a piece of paper, and cooled thereon, may be drawn off as a film, and on looking through the same exhibits a uniform structure. 100 gr. raw bee's wax are then added and the temperature is held to about 180°C., until the wax is entirely melted. Then the mass is poured upon a stone or wooden plate and allowed to cool thereon. Then, the product is ground, and is dissolved in a 10% tetralin solution, and allowed to rest for 24 hours.

If natural wax is used, thereby the best results are obtained from raw beeswax, of which relatively small quantities only are required. Also, in the selection of artificial waxes, it is necessary to pay attention that the melting point of these waxes be above 100°C. as much as possible. The addition of waxes for the mixture, is in the quantity from about two to four percent by weight, in relation to the weight of the fat.

As a solvent for the ground product in accordance with the invention, tetralin may be used.

Instead of raw beeswax, bleached beeswax, and benzol instead of tetralin, could be used.

Inorganic Colloid-Gelled Greases

Inorganically gelled lubricating greases claimed to show no dynamic corrosion characteristics and exhibiting greatly reduced emulsification characteristics are described in U.S. Patent No. 2,658,869 issued to Shell Development Company. Use is made of amorphus inorganic gelling agents containing a polyvalent metal and silicon, and used in a concentration of 2-25% by weight of the gelling agent. These amorphous agents include silicates, oxides, hydroxides, synthetic zeolites, etc. Magnesium is the preferred alkaline earth metal to be present, although calcium promotes the best qualities in a grease.

In order to promote maximum stability to water, a hydrophobic surface-active agent is absorbed on the surfaces of the gel. This agent can be the salt of a primary or secondary high molecular weight amine, such as a quaternary ammonium salt, an amine salt of inorganic acids, an amine salt of an organic acid, or other amino compounds. It is added in an amount of 5-70% of the weight of the gel.

The preferred grease, therefore, consists of 3-15% of a colloidal gelling agent such as calcium zeolite, barium zeolite, magnesium silicate-silica, etc., 30-65% of water-repelling agents, and at least 80% by weight of lubricating oil.

News Items

This year, about 1.303 billion lbs. of greases will be needed to keep the machinery of the U.S. running smoothly. (*N.Y. Times*, October 25, 1953 p. F5).

A study of mixed wheelbearing greases indicated their performance was not as good as that of the original wheelbearing lubricant. Standard Oil Development Co. workers find that electron micrograph evidence indicates that field performance causes structural changes in greases which cannot be simulated by any presently accepted lab tests (*N.Y.J. Comm.*, October 28, 1953 p. 11).

J. Roberts, Standard Oil Co. (Indiana) disclosed production of a new type grease which will lubricate bearings at high temperatures longer than any previous grease known. Also, it lubricates at temperatures as low as–40°F (*N.Y.J. Comm.*, October 26, 1953 p. 9).

Substituted ureas as grease thickeners–p-substituted arylureido derivatives of benzene and biphenyl are the best. Greases compounded from these thickeners and silicone oil are said to be non-corrosive, thermally and chemically stable, and have high melting point–Swakon et el (*Oil & Gas J.*, November 2, 1953 p. 70)

Westvaco Chemical Div. is offering trischloroethyl phosphite as an additive (*Chem. Wk.*, November 14, 1953).

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the happy go lucky service station attendant *who never checks anything.*

You'll see him here every *month* never doing anything for his customers that would be a *service* to them and a *profit* to him.

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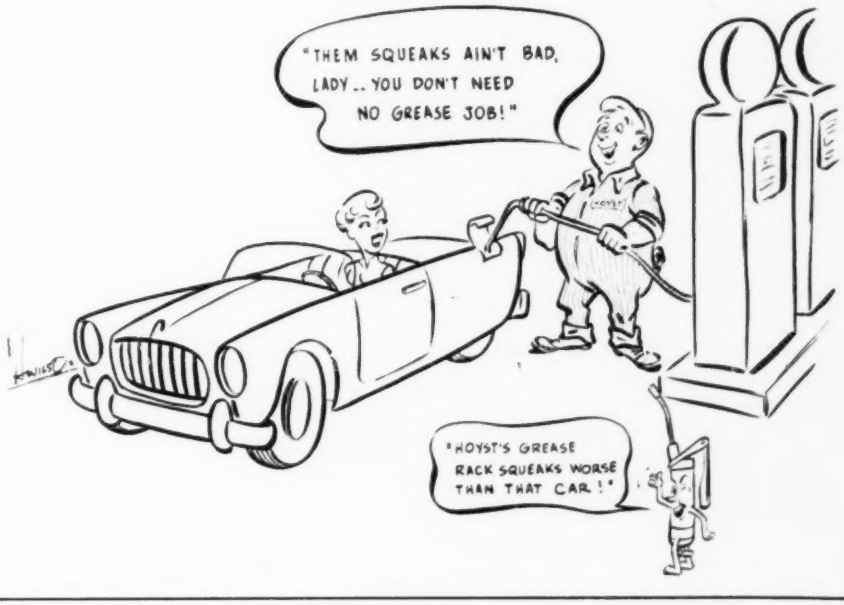

PEOPLE in the Industry

Daniel Honored for 35 Years of Service

Arthur J. Daniel just after the presentation of the portrait.

Arthur J. Daniel, president of the Battenfeld Grease & Oil Corporation, was presented with an oil portrait January 29 in a brief ceremony celebrating the company's thirty-fifth anniversary.

The portrait of Mr. Daniel was a gift of the employees and officers of Battenfeld as a tribute to his thirty-five years with the company. The painting was done by Daniel MacMorris of Kansas City.

The ceremony was held in the plant assembly room at Thirty-second and Roanoke Road.

Arthur Daniel helped to establish the Battenfeld Grease & Oil Corporation in 1919, and filled various offices with the company until 1947, at which time he was elected president to fill the position left vacant by the death of J. R. Battenfeld.

"Art" Daniel is a well known figure in the lubricating grease field, having been closely associated with the National Lubricating Grease Institute since it was organized in 1933. He has served the organization as vice-president, president, and is, at present, treasurer. Mr. Daniel is also a member of the American Society of Lubricating Engineers, The Society of Automotive Engineers, and the Lubrication Committee of the American Petroleum Institute.

Mr. Daniel has always been interested in the welfare of handicapped children, having filled various offices in the Missouri Society for Crippled Children and Adults, as well as the Jackson County Society for Crippled Children and Adults.

Rearick Joins Nofsinger

J. S. Rearick has joined the C. W. Nofsinger Company, Engineers & Contractors of Kansas City, Missouri, as Manager of Engineering. Previously he was with The M. W. Kellogg Company for over 16 years as Associate Director of Research, Development Engineer and Division Engineer. He was closely associated with the development of hydroforming, fluid catalytic cracking and various other petroleum and chemical processes. He is a member of The American Society of Mechanical Engineers, American Institute of Chemical Engineers, American Chemical Society, Instrument Society of America and National Society of Professional Engineers.

Frey Retires as API's Marketing Director

Retirement of Dr. John W. Frey as Director of the Division of Marketing of the American Petroleum Institute, effective March 1, and appointment of Adam J. Rumoshosky as his successor have been announced by President Frank M. Porter.

Porter also noted that as of March 1, transfer of the Marketing Division's headquarters from Washington to New York had been completed, and that henceforth these will be located in the Institute's main offices in Radio City.

Dr. Frey joined the staff of the Institute in February, 1947, after a long and fruitful career as an author, educator, historian, and public service official. He came to the Institute from the government, where he had been special assistant to the Director of the Oil & Gas Division of the Interior Department.

Under his direction, API's Division of Marketing expanded the activities and services which have proved so helpful to the distributors and companies moving petroleum products to the American consumers.

Dr. Frey's long and varied knowledge will not be lost to the industry, however, as a result of his retirement. He has been attached to President Porter's staff as a special consultant, and will continue to serve the industry in many ways.

Dr. Frey was born in Depue, Ill., March 8, 1889. He served in the U. S. Army in 1918, and received his B.S. from the University of Chicago in 1919. He was a student in the London School of Economics in 1922-23, and received his Ph.D., at the University of Wisconsin in 1926.

From 1920 to 1928, he was on the Geology and Geography Department Faculty at the University of Wisconsin. In the summers of 1925 and 1926, he was secretary of the round table on "Minerals in Their Political and Economic Aspects," of the Institute of Politics, Williamstown, Mass. He was with the Bureau of Foreign and Domestic Commerce, 1928-33, and the Federal Oil Conservation Board, in 1931 and 1932.

Delegates and wives attending our Annual Meeting will enjoy visiting San Francisco's famed China Town. For you and your wife it's the NLGI Annual Meeting—October 25-27, 1954 at the Mark Hopkins.

Every Operating Executive should know these Facts about . . .

Conventional Methods of Lubrication

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Automatic Centralized Lubricant Application

The inadequacy of the Oil Can and Grease Gun to meet today's machine lubrication requirements rests in the fact that this method provides NO ELEMENTS OF CONTROL. Lincoln Centralized Lubrication Systems provide all the requisites for CONTROLLING Application, and perform the function AUTOMATICALLY while machines are operating. For example:

THE RIGHT LUBRICANT

The proper lubricant, as pertains to all bearings served by a Centralized System, is determined from the data acquired by testing different lubricants under actual operating conditions.

EVERY BEARING LOCATED AND CONTACTED

Injector Valves are connected by rigid or flexible tubing to each bearing. A projected stem on the Injector visibly indicates the flow of lubricant to the bearings.

THE RIGHT QUANTITY

Knowledge of the lubricant capacity of a bearing need not rely upon mathematical or theoretical calculations. Injector Valves are externally adjustable to accurately deliver *the exact quantity* of lubricant required by each bearing.

THE RIGHT TIME

The pumping unit forces lubricant to all bearings in the system, simultaneously, at the specified time interval by means of the selective setting of the pressure developed by the central pump.

ADEQUATE LUBRICANT FILM

A bearing lubricant film can be maintained constantly by the control possible in timing the frequency of lubricant replenishment.

CONTAMINATION

Contamination of lubricant is eliminated when dispensing from an original refinery container or self-contained reservoir through the sealed injector circuit, direct to the bearing.

Apply the RIGHT LUBRICANT.
In the RIGHT QUANTITY.
At the RIGHT TIME.

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With the Federal Government, Dr. Frey held the following positions: member of the Petroleum Administrative Board in charge of Marketing, Interior Department, 1933-36; Associate Director for refining and marketing, Petroleum Conservation Division, 1936-41; Director of Marketing, Office of Petroleum Coordinator for War, 1941-42; special assistant to the Deputy Administrator, PAW, 1941-46; and special assistant to the Director of the Oil & Gas Division, Interior Department, 1946-47.

He was a member of the Energy Resources Committee of the Natural Resources Committee, 1938-42; is a member of the American Association of Geographers, Acacia and Sigma Xi. He was co-editor of the "History of the Petroleum Administration for War," and has contributed many articles on economic geography, mining economics and petroleum economics to technical journals.

New Director of the Marketing Division, Rumoshosky is a veteran employee of the Institute, having spent 17 years with the American Petroleum Industries Committee before his appointment as the Marketing Division's Associate Director last fall.

Simpson Joins R & D Staff

Douglas H. Simpson recently joined the Research and Development department of Foote Mineral Company as a Senior Analytical Chemist. He received his B. Sc. and M. Sc. degrees from McMaster University, Hamilton, Ontario, Canada and did graduate work at Purdue University from 1945 to 1947. He was employed by Wyandotte Chemicals Corporation prior to joining Foote.

Shell Appoints Banking Manager

John Paar, Jr., assistant manager of the banking department of Shell Oil Company, has been promoted to manager, succeeding J. L. Ledger, who has retired, it has been announced by A. G. Schei, treasurer.

Paar was born at St. Louis and joined Shell there in 1929 as cashier. In 1935, he was appointed chief clerk and five years later came to New York in the same capacity. He was made assistant manager in 1941.

Rheem Manufacturing Advances Hughes and Kelly

Andrew W. Hughes

Thomas A. Kelley

Rheem Manufacturing Co. has named Andrew W. Hughes to be Eastern Region manager in charge of all the company's manufacturing and marketing activities on the eastern seaboard.

Hughes, who has been with the company since 1943 in a variety of engineering, sales and administrative functions, will also be in charge of Rheem plant operations in Linden and Burlington, N. J., Philadelphia, Pa., and Sparrows Point, Md., according to W. S. Goodfellow, eastern division manager. He will make his headquarters at the Burlington plant.

Hughes is a member of the American Institute of Management, the American Ordnance Association, and the National Association of Cost Accountants. He is a native of Duluth, Minn. and a graduate of the University of Minnesota.

Rheem Manufacturing Co. has appointed Thomas A. Kelly, formerly manager of the company's Philadelphia plant, to the newly created post of Manager of Manufacturing Planning with offices at the firm's Richmond, Calif. corporate headquarters.

The new manufacturing planning department has been established to coordinate a variety of engineering and production activities throughout Rheem's U. S. and foreign plants.

Kelly, a graduate mechanical engineer who has been with the company since 1946, has been responsible for much of Rheem's research and development activity at the Philadelphia plant.

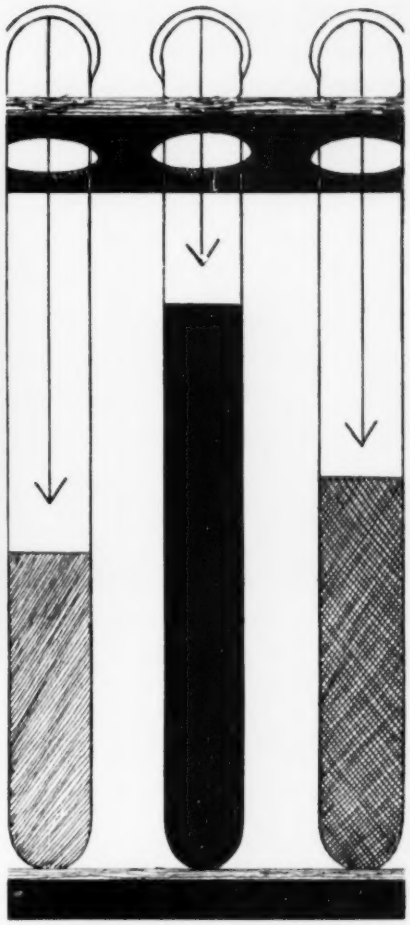
Seuren Promoted

William R. Seuren has been named assistant manager of industrial sales for Deep Rock Oil Corporation, it has been announced by W. W. Rice, manager of industrial sales.

Located in Chicago, Seuren will supervise sales and will contact industrial trade in Deep Rock's expanded midwestern sales territory including industrial sections of Canada. For the past two years Seuren has been industrial sales representative working out of Chicago.

Seuren came to Deep Rock in 1949 after receiving a master's degree in business administration at the Harvard School of Business in Boston. Earlier, he received a bachelor of science degree in chemical engineering from Pennsylvania State College and a master's degree in chemical engineering from Massachusetts Institute of Technology.

Going over the $2 billion mark for the first time, gasoline and other automotive taxes collected in 1952 by the federal government totaled $2,100,066,269.



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Rheem's National Container Products Manager

Harry H. Filler

Robert A. Behrmann

Harry H. Filler, veteran Rheem Manufacturing Co. executive, has been named National Container Products Manager in charge of all of Rheem's container and bulk packaging products.

Filler, who will make his headquarters at the Rheem plant in Chicago, assumes responsibility for coordinating planning, production, and marketing activities for Rheem's line of steel, fiber, and special purpose shipping containers.

Filler, who has been in charge of the company's East Coast operations, has handled many of Rheem's major expansions into new product lines and new manufacturing and marketing areas, including the establishment of Rheem plants in South America, the Far East, and Australia.

Emery Names Behrmann Director of Purchases

Emery Industries, Inc., has announced the appointment of Robert A. Behrmann as director of purchases. He fills the position vacated by K. K. Boyd sometime ago when the latter was elected vice-president in charge of sales and purchases.

Mr. Behrmann has had considerable background experience with Emery in the market development of new products as well as technical service on Emery's standard line of fatty acids and derivatives, plasticizers and textile products.

His technical background also includes a B.S. degree in Chemistry from Iowa State College, several years as a research chemist for the Shell Development Company, graduate work in organic chemistry at Purdue University, and a M.B.A. degree from the Harvard Business School.

Guzzo Becomes Gulf Vice President

Mr. C. J. Guzzo has been elected a Vice President of the Gulf Oil Corporation and Gulf Refining Company.

A veteran of 40 years of service, Mr. Guzzo has been Division General Manager of the company's New Orleans sales territory since 1949.

One of New Orleans' most civic-minded citizens Mr. Guzzo has always devoted a portion of his time to civic activities. He is a member of the Board of Directors of the New Orleans Chamber of Commerce, Past Chairman of the Members' Council, Past Chairman of the New Orleans Sales Executives Council, Past President and a member of the Board of the New Orleans Rotary Club, on the Boards of the Tuberculosis Association, Louisiana Manufacturers Association, the Petroleum Club, and the famous International House at New Orleans. Mr. Guzzo is also a member of the New Orleans Better Business Bureau, Pickwick Club, and is active in the Community Chest and Red Cross.

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Find out how *you* can benefit with Votator Grease Making Apparatus. Write The Girdler Company, Votator Division, Louisville 1, Kentucky. *VOTATOR—Trade Mark Reg. U.S. Pat. Off.

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A DIVISION OF NATIONAL CYLINDER GAS COMPANY
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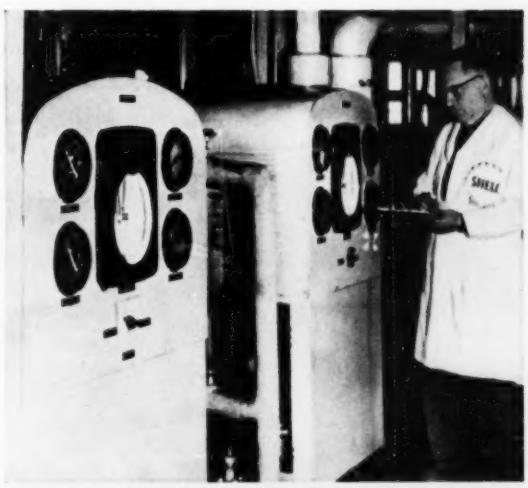

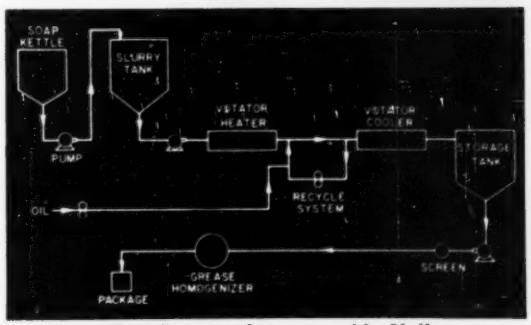

Flow diagram of process used by Shell

Industry NEWS

API Motion Picture Wins International Honors

"Farm Tractor Safety," a motion picture produced by the Committee on Agriculture of the American Petroleum Institute, has been awarded top honors in the educational-technical film division at the International Festival of Agricultural Films in Rome. More than 30 countries participated in the Festival.

The Institute's motion picture was entered by the U. S. Information Service office in Rome.

The award received by "Farm Tractor Safety" is known both as the "Gold Head of Wheat," and the "Gold Leaf." It is a beautiful replica, in gold statuette form, of a head of wheat. It is nine inches high, and is mounted in an attractive velvet case.

"Farm Tractor Safety" is a 16-millimeter sound, full-color motion picture presenting the "do's and don'ts" of safe tractor operation. Many of the country's leading agriculturalists have hailed it as an outstanding film for youth and adult groups, and particularly for 4-H clubs and vocational agriculture classes.

It was produced late in 1951 by the George W. Colburn Laboratories, and photographed by Henry Ushijima for the Committee on Agriculture.

To date, 374 prints are in circulation. More than 50 companies have purchased prints for distribution in their marketing territories. In addition, the Committee on Agriculture provided free prints to all state colleges of agriculture in the U. S. and its territories. It has been cleared for television, and many of these outlets have shown "Farm Tractor Safety" as public service presentations.

The Italian Festival award is the most recent honor awarded to the motion picture. Previously, it had been awarded the coveted Blue Ribbon of the American Society of Agricultural Engineers, and cited by the National Committee on Films for Safety.

It was produced under the supervision and with the cooperation of leading farm safety specialists. It is dedicated to reducing the annual toll of injuries and deaths resulting from tractor accidents.

Emery Dibasic Acid Available

Commercial quantities of azelaic acid are now available. Designated Emerox 1110, it is the commercial product from Emery's new ozone-oxidation plant which has been under construction for the past year.

Although Emery has produced azelaic acid for the past eight years, most was for captive use. The additional quantities now available open up a practically new source for dibasic acids and further widens the selection of dibasic raw materials available to manufacturers.

Typical Characteristics of Emerox 1110 Azelaic Acid are as follows:

Acid Value	565
Combining Weight	100
Melting Point	95-99° C
Color, FAC	5
Sp. G. @ 110° C	1.038
Azelaic Acid Content	87%
Other Dibasic Acids	13%

This production of azelaic acid has culminated several years of pioneering into the commercial use of ozone as an oxidant by both Emery and the

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Titre	8° C.—10° C.
Cloud Point	46° F.—49° F.
Color Lovibond 1" Red	3—6
Color Lovibond 1" Yellow	15—30
Unsaponifiable	1.5% max.
Saponification Value	197—200
Acid Value	196—199
% F.F.A. as Oleic Acid	98.5—100
Iodine Value (WIJS)	88—93
Refractive Index 50° C. (Average)	1.4495

Write for our free booklet "Fatty Acids In Modern Industry."

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Welsbach Company of Philadelphia, manufacturers of the ozone generating unit. In the new process, oleic acid, a basic product of Emery, is oxidized at the ethylenic linkage to form an ozonide. This in turn is decomposed to yield two aliphatic acids, azelaic (dibasic) and pelargonic (monobasic). Both of these nine carbon acids promise to be important raw materials for the chemistry process industry.

The unique characteristics of azelaic acid, coupled with increased availability broadens the scope of interest in this dibasic acid as a raw material for plasticizers, resins, polyamides, polyesters, alkyd resins, and synthetic lubricants.

Samples of and literature on Emerox 1110 Azelaic Acid are available on request from Emery Industries, Inc., Dept. 5, Carew Tower, Cincinnati 2, Ohio.

Quaker State to Build Two New Plants

Quaker State Oil Refining Corp. announces it has awarded construction contracts for two new gasoline processing units at Emlenton, Pa., and St. Marys, W. Va.

President Walter R. Reitz said both units will utilize a newly-developed platforming process which upgrades low octane gasoline into high octane fuel by using platinum as a catalyst.

The new units will be constructed as additions to the Quaker State refineries at Emlenton and St. Marys by Procon, Inc., of Des Plaines, Illinois.

Mr. Reitz said each unit will have a capacity of 850 barrels a day. A third unit, capable of producing 1,500 barrels a day, already is under construction at the company's refinery near Bradford, Pa., and is scheduled to go on stream in the spring.

Mr. Reitz explained that in the process of changing the chemical structure of low octane straight run or natural gasoline, the charge stock is mixed with hydrogen and passed at high temperature and high pressure over the platinum-containing catalyst. The resulting action upgrades the low octane material into a choice motor fuel blending component.

This is then blended with straight run gasoline or gasoline obtained by "cracking" processes. The end result is a gasoline having an octane rating well into the 90's after the addition of tetraethyl lead.

SBA Announces New Booklet

Help for small manufacturers in gearing their marketing operations for stiffer competition is offered in a new booklet published by the Small Business Administration, SBA Administrator Wendell B. Barnes has announced.

The booklet, *Making Your Sales Figures Talk*, is Number 8 in the series of small business Management Aids, and tells the owner of a small business how he can use his own sales figures to develop his markets and cut selling costs. The booklet is available from the U. S. Superintendent of Documents, Washington 25, D.C., for 20 cents a copy.

As defense needs are reduced, sales problems take top priority over production problems, the booklet points out. Many small manufacturers will therefore find it important to take their marketing activities apart—just as they have become used to analyzing their production operations—to find ways of making them more efficient.

Mr. Barnes said that a particularly valuable feature of the booklet is the chapter on sources of information a small business owner can use in ana-

MALMSTROM NIMCO BRAND WOOL FAT & LANOLIN

Lubricating grease manufacturers know that top value and peak performance go hand-in-hand. That's why Malmstrom's NIMCO brands are specified. N. I. Malmstrom – largest processors of wool fat and lanolin products – produce quality components for grease production.

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WOOL GREASE FATTY ACIDS

Moisture	2% max.
Unsaponifiable (Wool Grease Alcohols)	6% max.
Saponifiable	94%
Free Fatty Acid (as oleic)	55-60%
Actual Free Fatty Acid Content	90%
Saponification No.	120-130
Free Inorganic Acid	0.2% max.
Iodine Value	20-40
Apparent Solidification Point (titre)	Approx. 44° C.
Softening Point	45-48° C.
% Sulfur	No corrosive sulfur

A.O.C.S. Methods

lyzing his own selling operations. In addition to the internal records—orders received, salesmen's call reports, and production reports—many of the more helpful external sources of data are listed. These include trade associations, census reports, and trade publications.

The booklet goes on to explain how the businessman can use this kind of information to improve his own distribution operations; first in analyzing his sales volume by product groups, by geographical location, and by trade channels; next in breaking down his costs of distribution by type, by products, by class of trade, by territory, and by class of market area.

Bauxite Supplier Sold

The Attapulgus Minerals & Chemicals Corporation has bought the American Cyanamid Company's one-half interest in the Porocel Corporation, making the latter a wholly-owned Attapulgus subsidiary, it has been announced. Porocel operates a plant at Berger, Ark., making products for the bauxite, adsorbent and catalyst markets. It has concluded a long-term bauxite supply contract with American Cyanamid.

Lubrication Committee Distributing Copies of "Lubricate for Safety Every 1,000 Miles"

The API's Lubrication Committee says this is the time to educate motorists that they should lubricate their chassis every 1,000 miles—no matter whether they drain their crankcases at 500 miles, 1,000 miles or 2,000 miles.

That's the message you can obtain in reprint form from recent Chek-Chart Service Bulletin now being distributed by the Committee whose officers have asked their members to get a supply of these reprints for distribution. Purchase price is at cost.

Reprints of the article may be obtained at a cost of $2.25 per 100 copies from: A. J. Rumoshosky, Division of Marketing, American Petroleum Institute, 50 West 50th Street, New York 20, New York.

New Du Pont Fund

A fund of $238,500 for grants to universities and colleges to advance the teaching of science has been announced by the Du Pont Company.

In recognition of this need, the company has now made advancement of teaching the largest single part of its aid-to-education program, which for many years has also provided grants for fundamental research and postgraduate fellowships. Under the whole program it has authorized a total of more than $700,000 for the 1954-1955 academic year as compared with $600,000 for the present year. In the longer standing plans in the program, the company is granting $230,000 for fundamental research and $222,000 for postgraduate fellowships in science and engineering.

Du Pont is making the new awards to selected institutions and leaving decisions on detailed use of the funds up to them. The company is awarding 61 postgraduate fellowships in scientific fields, granting 26 in chemistry, 17 in chemical engineering, six in biochemistry, five in physics, four in mechanical engineering, and three in metallurgy. It also is continuing its grants-in-aid of $15,000 each to ten universities and $10,000 each to six universities. These grants are to build up knowledge through the support of unrestricted fundamental research in chemistry.

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FUTURE MEETINGS of the Industry

MARCH, 1954

8-10 American Inst. of Chemical Engineers, Statler Hotel, Washington, D. C.

8-10 Texas Oil Jobbers Assn. (annual convention exhibit), Baker Hotel, Dallas, Texas.

8-10 Oil Industry Information Committee, Shamrock Hotel, Houston, Texas.

16-18 Ohio Petroleum Marketers Assn. (annual convention and marketing exposition), Deshler-Hilton Hotel, Columbus, Ohio.

17-19 American Petroleum Institute (Division of Production, Mid-Continent District), Skirvin Hotel, Oklahoma City, Okla.

17-18-19 American Petroleum Institute (Division of Production, Mid-Continent District), Biltmore Hotel, Oklahoma City, Okla.

24 to April 1 American Chemical So-Society, Kansas City, Mo.

29-31 Western Petroleum Refiners Assn., Plaza Hotel, San Antonio, Texas.

APRIL, 1954

5-7 American Society of Lubrication Engineers (Annual Meeting and Exhibit), Netherland Plaza Hotel, Cincinnati, Ohio.

8-9 American Petroleum Institute (division of production, Rocky Mountain district), Townsend Hotel, Casper, Wyo.

12-15 Society of Automotive Engineers (national aeronautical meeting, aircraft engineering display, and aircraft production forum), Hotel Statler, New York, N. Y.

14-16 National Petroleum Assn. (51st semi-annual meeting), Cleveland Hotel, Cleveland, Ohio.

MAY, 1954

2-4 Independent Petroleum Assn. of America (midyear meeting), Cosmopolitan Hotel, Denver, Colo.

3-5 American Petroleum Institute (Lubrication Committee), Skytop Lodge, Skytop, Pa.

3-7 American Petroleum Institute (safety & fire protection committees, midyear meeting), Chase-Park Plaza, St. Louis, Mo.

6-7 American Petroleum Institute (division of production, Pacific Coast district), Statler Hotel, Los Angeles, Calif.

6-8 National Tank Truck Carriers (6th annual convention), Netherland Plaza, Cincinnati, Ohio.

9-11 Empire State Petroleum Assn., Roosevelt Hotel, New York, N. Y.

10-12 American Petroleum Institute (Division of Transportation, Products Pipe Line Conference), Warwick Hotel, Philadelphia, Pa.

10-13 American Petroleum Institute (Division of Refining, Midyear Meeting), Rice Hotel Houston, Texas.

16-19 American Inst. of Chemical Engineers, Springfield, Mass.

17-19 American Petroleum Institute (Division of Marketing, Midyear Meeting), Cosmopolitan Hotel, Denver, Colo.

24-25 Packaging Institute (petroleum packaging committee), Cleveland, Ohio.

31-June 5 American Petroleum Institute (division of production, midyear committee conference), San Francisco, Calif.

JUNE, 1954

3-4 Pennsylvania Grade Crude Oil Assn., William Penn Hotel, Pittsburgh, Pa.

6-11 Society of Automotive Engineers (summer meeting), The Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

13-18 American Society for Testing Materials (annual meeting and exhibits), Sherman Hotel, Chicago, Ill.

17-19 American Petroleum Institute (Division of Production, Eastern District), Greenbrier Hotel, White Sulphur Springs, W. Va.

21-25 American Inst. of Electrical Engineers (combined summer and Pacific general meeting), San Francisco, Calif.

AUGUST, 1954

16-18 Society of Automotive Engineers (national West Coast meeting), Los Angeles, Calif.

SEPTEMBER, 1954

12-16 Society of Automotive Engineers (national tractor meeting), Schroeder Hotel, Milwaukee, Wis.

12-16 American Inst. of Chemical Engineers, Colorado Hotel, Glenwood Springs, Colo.

12-17 American Chemical Society, New York, N. Y.

13-14 Packaging Institute (petroleum packaging committee), Philadelphia, Pa.

15-17 National Petroleum Assn. (52nd annual meeting), Traymore Hotel, Atlantic City, N. J.

27-28 Independent Oil Compounders Association (7th annual meeting), Sheraton Hotel, Chicago, Illinois.

OCTOBER, 1954

4-9 Society of Automotive Engineers (national aeronautic meeting), aircraft engineering display, and aircraft production forum, Hotel Statler, Los Angeles, Calif.

10-12 National Assn. of Oil Equipment Jobbers (4th annual meeting), Congress Hotel, Chicago, Ill.

Week of
Oct. 18 Society of Automotive Engi-

neers (national transportation meeting), Boston, Mass.

20-21 Nebraska Petroleum Marketers Assn. (annual convention), Paxton Hotel, Omaha, Neb.

23-25 National Association of Oil Equipment Jobbers (annual meeting), Hotel President, Kansas City, Mo.

25-26 Independent Petroleum Assn. of America (annual meeting), Tulsa, Okla.

25-27 NLGI ANNUAL MEETING, MARK HOPKINS HOTEL, SAN FRANCISCO, CALIF.

25-29 American Institute of Electrical Engineers (fall general meeting), Chicago, Ill.

26-27 Society of Automotive Engineers, national diesel engine meeting, Hotel Statler, Cleveland, Ohio.

NOVEMBER, 1954

1-2 Independent Petroleum Assn. of America (annual meeting), Shamrock Hotel, Houston, Texas.

4-5 Society of Automotive Engineers (national fuels and lubricants meeting), Mayo Hotel, Tulsa, Okla.

8-11 American Petroleum Institute (34th annual meeting), Conrad Hilton Hotel and Palmer House, Chicago, Ill.

28 to Dec. 3 American Socy. of Mechanical Engineers, Statler Hotel, New York, N. Y.

29-30 Packaging Institute (Petroleum Packaging Committee), New York, N. Y.

DECEMBER, 1954

12-15 American Inst. of Chemical Engineers (annual meeting), Statler Hotel, New York, N. Y.

JANUARY, 1955

10-14 Society of Automotive Engineers (golden anniversary annual meeting), The Sheraton-Cadillac Hotel and Hotel Statler, Detroit, Michigan

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Producers of lubricating greases are turning to high-quality, uniform "DISTAL 42". This distilled fatty acid is light in color, free of moisture, glycerine and protein. An extremely low linoleic acid content, the absence of triglycerides, and a low ester number make DISTAL 42 ideal for lubricating greases as well as hand cleaners, soaps, and chemical specialties.

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Titre	40 to 43°C
Acid Number	200 to 205
Iodine Value	40 to 60
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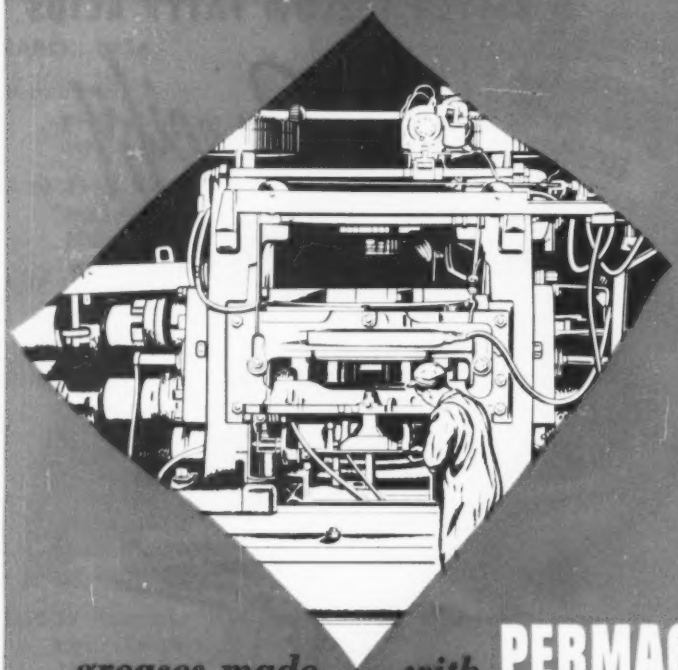
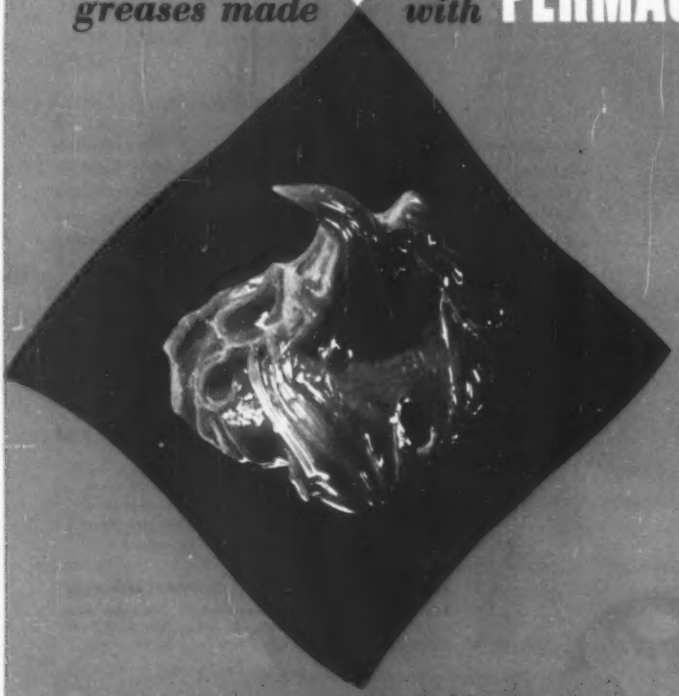


Latest good news for grease makers and grease marketers is about Permagel—Attapulgus' new thickening agent for making high quality, multi-purpose greases. Greases formulated with this pure, inorganic material maintain their consistency over a wide range of temperatures. They actually have no melting point, and display good low temperature properties as well.

Think of what this means . . . one grade of grease for winter *and* summer operation . . . use of one grade instead of two or three for normal or high temperature applications . . . or, one grease doing multi-purpose duty. Obvious results: lower inventory requirements and lower grease costs—with dependable grease performance! And, use of a multi-purpose Permagel grease greatly reduces the possibilities of misapplication

greases made with PERMAGEL *offer thermal stability*



always present when single-purpose greases are stocked.

There are many other Permagel advantages, too. Dispersed in lubricating oils, Permagel's needle-like particles result in stable multi-purpose greases that are unusually tough in high shear service. Permagel greases resist washout by water and at the same time offer outstanding protection against corrosion. Another big feature of Permagel is its uniformity from shipment to shipment, which practically insures grease reproducibility.

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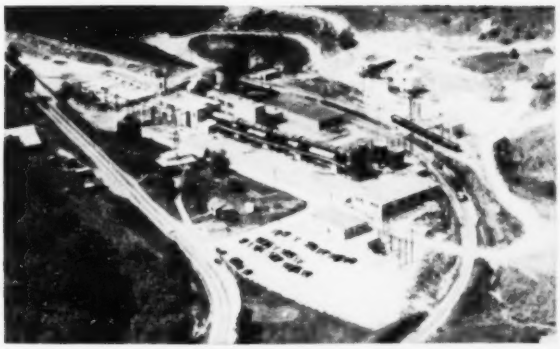

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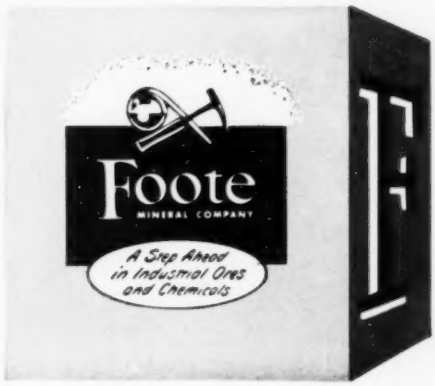

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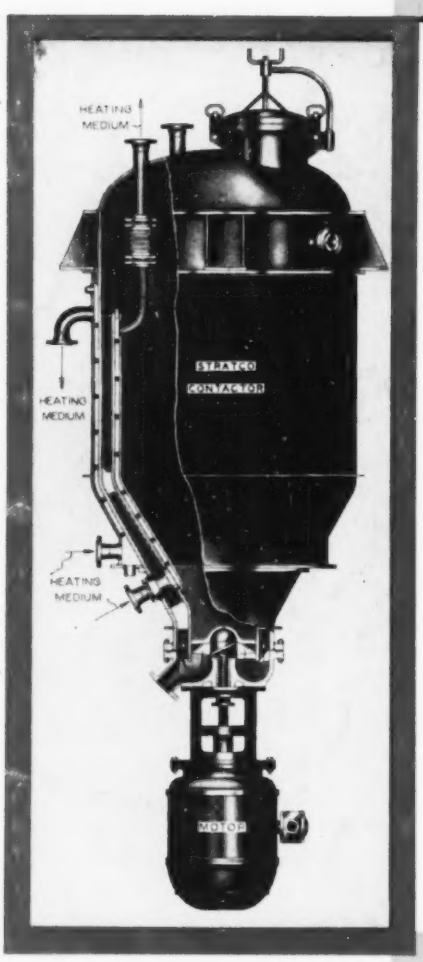

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